AMERICAN ENGINEER AND RAILROAD JOURNAL.

JULY, 1900.

# MASTER CAR BUILDERS' ASSOCIATION.

## THIRTY-FOURTH ANNUAL CONVENTION.

### Saratoga, New York, June, 1900.

The convention was called to order at 10 a. m., June 18, by the President, Mr. C. A. Schroyer. After the opening prayer by the Rev. Delos Jump, the President introduced the Hon. John Foley, President of the Village Board of Saratoga, who welcomed the association to its seventh convention held there. He referred in a happy way to the inspiring character of the work of the Association and the appreciation of its accomplishments.

President Schroyer then read his address. The past year was referred to as a notable one in the Association, and the past decade was characterized as the most wonderful one in its history. Many things had contributed to the generally satisfactory condition of the country, one of which was the railroad system whereby transportation was made cheaper and quicker than anywhere else in the world. The car building interests occupied in this work held great responsibilities which merited careful and honest consideration of the questions of vital interest coming before this organization.

The total number of cars in the country was placed at 1,356,861, which was an increase during the year of 8,730. The number of cars represented by the membership in the Association was 1,348,131, and at the beginning of last January 1,191,189 cars had been equipped with automatic couplers, since which time practically all of the rest had been so fitted. The speaker referred at length to the fact that sufficient attention had not been given to the maintenance of unlocking devices. This had received the attention of the Interstate Commerce Commission, which had pointed to the fact that couplers defective in this respect were not automatic in that they often required men to undergo the danger of going between the cars. Mr. Schroyer recommended more attention to adherence to the standard construction; he would like to see all the standards covered by the interchange rules. We think that this would be an excellent way to enforce the standards. It has been suggested before, and will probably be accomplished next year. The speaker mentioned the fact that during the year no triple valves had been submitted to the standing committee on that subject, and the same was true of brake shoes. He suggested the desirability of taking the stand, as members of the Association, that new brake shoes submitted for trial on roads should be required to first come before the Brake Shoe Committee for test. An unusual loss of members by death was sustained this year, the number being eleven.

The report of the Secretary and Treasurer showed the condition of membership and finances to be satisfactory. During the year there had been an increase of five in the membership, which, at this time, stands as follows: Active members, 265; representative, 190; and associate members, 8; making a total of 463, as against 458 last year. The amount of cash in the treasury at the time of the convention was $9,836.22, with all bills paid. It was decided that the membership dues should remain without change for the year. A worthy precedent was established in the appointment of the following four members as a nominating committee: Mr. John Kirby, R. C. Blackall, Wm. Mc. Wood and John Hodges. These are men who have been in the councils of the Association for many years.

### REPORTS AND DISCUSSIONS.

In this issue we print abstracts of the most important reports, which will be continued in the following number.

### Standards and Recommended Practice.

The brevity of this report indicated the general satisfaction with present standards. There were but five recommendations, one of which was in the form of a new design for a journal box and details for 5 by 9-inch axles. The Chairman, Mr. Waitt, urged in strong terms the importance of more uniformity in construction and better maintenance of uncoupling attachments. He presented a suggestion from Mr. Moseley, Secretary of the Interstate Commerce Commission, to the effect that the interchange rules should require the maintenance of coupler unlocking attachments. This was referred to the Arbitration Committee for report later in the convention. With reference to Screw Threads, Bolt Heads and Nuts, the Association considered the recommendations of last year in favor of the adoption of the manufacturers' standard in place of the old sizes, and voted to submit the question of the change to letter ballot for adoption as a standard. Mr. B. Haskell believed it advisable to bring the subject before the American Society of Civil Engineers with the object of securing similar action in connection with bridge bolts, and the necessary action was taken.

The committee recommended in the specifications for steel axles a reduction in the percentage of carbon. It was considered unwise to allow the proportion of carbon in freight car axles used in interchange service to go beyond 0.4 per cent., limiting the proportion in these axles to from 0.4 to 0.25 because of the rough usage of this service, with particular reference to the danger of damage in sudden cooling of hot boxes. Mr. E. D. Nelson cautioned against precipitate action and suggested further investigation by a special committee. Mr. Wm. Forsyth believed it unwise to reduce the carbon without reference to the size of axles, it being established that it was important to have more carbon in large than in small axles. It was clearly an important matter, the size of the axle must be considered, and was referred for report by a special committee next year, who should investigate the question of chemical composition of all steel car axles.

### TOPICAL DISCUSSIONS.

"When pressed steel trucks are broken on a foreign road should not repairs be made by the manufacturers or the owners, in place of repairs being attempted by the road on which the car may be?"

Mr. B. Haskell opened the discussion. Thus far there had been comparatively little damage to these trucks, but the necessity for having formers for doing such work made it advisable to take some action as to who should make the repairs. Several members thought it necessary for roads to prepare to do this work themselves, because the use of metal trucks was sure to increase. Mr. Rhodes urged the importance of directing the attention of the manufacturers to the necessity of constructing these trucks with a view of facility of repairs. This had not received enough attention in the past. Mr. Waitt supported the opinion in favor of simplicity, which would render it possible to carry repair parts and apply them easily. At present his practice was to send an accumulation of damaged trucks to the manufacturers for repairs.

"How soon after a new car is built should it be reweighed to modify the original stencil weight; at what intervals should it be reweighed thereafter, and what should be the minimum variation from the previous stenciled weight for which change should be made?"

This was opened by Mr. Delano. The Burlington had a rule requiring reweighing annually, but this was not always done. The drying out of a car during the first hot season amounted sometimes to 1,500 lbs. Accuracy in stenciling light weights of cars was shown to be important from a traffic standpoint. The speaker thought it advisable to take definite action which should render the marked tare weights correct, honest and reliable. Mr. Waitt moved the appointment of a committee to consider the whole subject as stated above, with reference to both foreign and domestic cars, and this was carried.

"Should the link slot and pin hole in the knuckle of M. C. B. coupler be closed?"

Mr. G. L. Potter reviewed the desirability of removing the difficulties due to the weakening of the knuckles in this way. It was shown to be necessary to take up the question of hauling cars out of very sharp curves. The abolition of the slot and retention of the pin holes, the tops of the pins serving for attachment of the ordinary links, was shown to be inadequate. Service in car ferry work, where the question of tides was troublesome, and on mountain roads, required something more than this. There were so many special requirements to be provided for that this action should not be taken until a satisfactory substitute was ready. Mr. Delano thought it possible to reduce the size of the openings even if they could not be filled up entirely. There was no definite action on the question.

## REPORTS.

### Brake Shoe Tests.

This committee did not consider it one of their functions to test brake shoes unless they had passed the experimental stage, and considered it wise to wait until a number of recent new shoes had been in use for a longer time, deferring report upon these until next year. In the mean time those who desired to submit shoes to test could do so at Purdue University, where the machine is now located, paying for the work. Mr. Delano wished to have the association informed as to the results of independent tests which have been made at Purdue. The results of these, however, are now private information and confidential. This led to a suggestion by Mr. F. M. Whyte recommending asking the committee for specifications of the coefficient of friction for brake shoes. Shoes could then be tested and those which came within the required limits could be brought before the railroads in a very satisfactory condition. This was ordered.

### Triple Valve Tests.

The second session opened with the consideration of this subject, which was introduced verbally by Mr. Rhodes. The committee had carried out the instructions of last year inviting the air brake manufacturers to be represented in a meeting to consider revision of the code of tests for triples prior to making comparative tests. The efforts of the committee had not been successful in securing co-operation from the New York Air Brake Co., and no progress had been made. It appeared in the discussion that the Association had gone as far as it could to secure tests through such co-operation. The matter stands where it was left last year, with no apparent hope for a test.

### Interchange Rules.

The interchange rules for freight cars were adopted as revised by the arbitration committee and prices as recommended by the committee on prices. This was a good piece of work, which occupied but two and a quarter hours. The passenger interchange rules created an unexpected amount of discussion and the suggested revision was finally voted down because many considered it too radical.

### Wheel Circumference Measure.

This report, which contained a design for an improved circumference measure, was ordered submitted to letter ballot.

### Design for Journal Box, Bearing, Wedge and Lid for 100,000-Pound Capacity Cars.

This report was criticised in certain particulars. The gauges submitted were incomplete in some ways. The matter of gauges for boxes and wedges was referred to a committee for report next year and the report itself was ordered to letter ballot.

### Loading Long Material.

This subject has been before the Association for several years and great improvements have been effected in loading materials, which from their form or weight are awkward to handle in trains. Besides lumber, such freight as logs, pipe, stone, ties and tan bark are provided for. The report of this year includes the former rules brought up to date to meet newly developed conditions by a number of important additions and a few minor changes. Mr. Leeds, of the Louisville & Nashville, has pulled the laboring oar in this work and deserves a great deal of credit for the rules. The report was referred to letter ballot as recommended practice.

### Center Plates.

In the presentation of the report the necessity for smooth-fitting and adequate lubrication was made prominent. Ideas as to center plates were shown to be of great variety and necessity for lubrication was apparent.

### Side Bearings.

This and the previous subject were considered simultaneously. It was at once apparent that these have a very important bearing on the design of cars. There was a strong inclination to favor further investigation of the action of roller side bearings. A report will be made next year by a committee in which side bearings and center plates will be considered as parts of the same subject. It was regretted that the committee on center plates could not recommend anything as a standard.

### Draft Gear.

Experiments seem to be necessary in order to establish the weak points in draft gear. Mr. Bush estimated the proportion of cars on repair tracks for draft gear repairs at 30 per cent. of the whole number to be found in yards. Not only the draft gear was affected, but also the entire ends of the cars. The fact that there are few locomotives now used in heavy freight service which cannot exert more than 30,000 lbs. tractive force and the present low limit of capacity of ordinary draft gear to about 19,000 lbs. showed how inadequate present draft gear is. Mr. Rhodes supported Mr. Bush in regard to the necessity for tests and considered draft gear improvement absolutely necessary. The whole question was referred to the committee again and the executive committee instructed to outline tests. Mr. Delano recommended the rear ends of tenders as a favorable place for testing draft gear, because of the severity of the service which gave results quickly. The Westinghouse friction draft gear was prominently mentioned as being worthy of attention by the committee.

### Air Brake Appliances and Specifications.

Careful instruction to repair men was shown in the discussion to be very important, especially in oiling the brake cylinders. The chief item in construction requiring attention seemed to be the avoidance of angles and bends.

### Tests of Master Car Builders' Couplers.

The committee had not been able to test any couplers during the year, but had confined its efforts to redesigning the apparatus for testing which was put into the form of working detailed drawings. Purdue University has offered to build the machine at its expense under the direction of the committee, placing it at all times at the disposal of the Association.

In addition to this gauges, the marking of couplers, increased size of the coupler shank and the advisability of closing up the link slot and pin-hole in coupler buckles were brought up by the committee. Mr. Waitt proposed an arrangement for testing couplers whereby a coupler may be submitted to the committee by any road represented in the association and the tests will be made at the expense of the association.

## TOPICAL DISCUSSIONS.

"To what extent is it desirable to equip cars with permanent check chains now shown under recommended practice of the Association."

This subject was introduced by Mr. Sanderson, and as the discussion brought out the close relations between this subject and that of metal dead-blocks, it was referred for consideration to the committee on this subject.

"Good Methods for Terminal Cleaning of Passenger Cars. Is it advisable to have oil in cleaning mixtures?"

Prominence was given in the discussion to the destruction of the varnish caused by washing the previously dry surface of the cars, except at relatively long intervals. The use of water unnecessarily was found to be as destructive to the life

of the varnish as the weather, too frequent washing with water causing cracks in the varnish. Considerable care should be used in the employment of oil in the compound used for cleaning and cutting the dirt. The use of oil, such as linseed, formed a thin skin on the surface when dry, covering up the dirt in the cracks, and in the beading work of the trimmings, and this was difficult to remove. The practice of the New York Central was to use the cleaners not oftener than once in three months. Water was used only in wet weather, the dry cleaning sufficing at all other times. The cost of cleaning cars varied considerably on different roads. On the Chesapeake & Ohio it was 30 cents per thousand miles for cleaning both the inside and outside, which was taken as an average figure. In view of the technical character of the subject, and the fact that only painters were sufficiently informed to treat it properly, the topic was referred to the Master Car Painters' Association.

### Closing Business.

The closing business included the usual resolutions of thanks to those who had contributed to the success of the convention, and the election of officers resulted as follows: President, Mr. J. T. Chamberlain; First Vice-President, Mr. J. J. Hennessey; Second Vice-President, J. W. Marden; Third Vice-President, A. W. Brazier; Executive Committee, E. D. Bronner, J. H. McConnell and William Apps; Treasurer, John Kirby.

## AMERICAN RAILWAY ASTER MECHANICS' ASSOCIATION.

### THIRTY-FOURTH ANNUAL CONVENTION.

**Saratoga, New York, June, 1900.**

The convention was called to order at Saratoga June 20, 1900, by President J. H. McConnell. The prayer was offered by the Rev. Dr. Jump, and the opening address was delivered by Mr. A. J. Pitkin of the Schenectady Locomotive Works. The speaker in a happy way directed the thought of the Association in the direction of the responsibilities brought to the members by the fact that the locomotive must earn every dollar of revenue of the railroad. The present bearing of the locomotive in transportation was expressed in the reference to the fact that 1¾ pounds of coal, which could be held in the hand, contained sufficient energy when burned in a locomotive firebox to transport a car containing 1,000 bushels of wheat one mile. This also testified to the perfection of present designs.

The president in his address stated that the affairs of the Association were in the usual satisfactory condition. The year had been a remarkable one in locomotive work, both foreign and domestic. During the year 1899, 2.196 locomotives, costing $25,000,000, were built in the United States.

The recent great advance in weights of locomotives was commented upon in connection with the increase in cylinder power as indicating remarkably rapid development. Tenders had not been behind the locomotive in growing. Cast steel had advanced in favor for locomotive parts; nickel-steel had not yet come into general favor, but piston valves were rapidly gaining. The increased power of the locomotive was the most important and promising improvement. Train weights had greatly increased and the value of the tonnage rating system was recognized in showing the advantages in their true light. The compound was advancing, 330 having been built in the year 1899. Shop practice, electric driving, compressed air, improved tools received the speaker's attention in a statement favoring the use of methods which seemed to be best adapted to the special conditions in shops. In reviewing the subjects before the convention, the speaker gave special prominence to the comparison of statistics on the ton-mileage basis and uniformity in making up statistics for the same work for various purposes.

The reports of the secretary and treasurer were received. The membership stood as follows: Active, 620; associate, 19; honorary, 26; total, 665. The finances were in equally satisfactory shape; the amount of cash in the treasury was $3,468.47, with all bills paid.

The four scholarships at Stevens Institute of Technology were all filled, and as a vacancy will be open for the autumn examinations, candidates should communicate at once with the Secretary. There are at present no applicants, and Mr. MacKenzie moved that the privileges of the scholarships should be extended to the locomotive works in case there are no applicants from the railroads. The preference stands as follows: First, the sons of railroad men; second, railroad employees who may not be sons of members; and last, boys employed in locomotive works.

A lot of time was spent over the question of the admission of several honorary members, but steps have been taken to avoid a repetition of the occurrence.

### REPORTS.

"What Can the Master Mechanics' Association do to Increase its Usefulness?"

This sort of report was a novelty, and we present its conclusions elsewhere. In spite of the fact that the report contains a pointed criticism of the practice of reading reports in full, the Chairman of the committee was specially requested to read it in full. This is mentioned because a presentation of papers by abstract is generally considered vitally important in the prompt conduct of business.

The report contained a number of suggestions which, if carried out, would require changes in the constitution, and a resolution offered in the report referring them to a committee for further report resulting in the appointment of Messrs. Quayle, Vauclain and Gillis. The matter of the preparation of an elaborate index of the proceedings was referred to a committee, Messrs. F. A. Delano, S. P. Bush and C. M. Mendenhall.

Mr. Deems emphasized the importance of the suggestion of the committee with reference to preparation for the discussion of the subjects, and also of the consideration of many important features of motive power work outside of the locomotive. Many of the suggestions will probably be acted upon next year. It would be a good plan to have such a report every five years.

### TOPICAL DISCUSSIONS.

"Nickel Steel as a Journal Bearing. Is there any noticeable increase in friction or wear, as compared with the ordinary steel or iron?"

Mr. W. H. Lewis, who presented this subject, had no reason to believe that it did not make a good bearing. Mr. Vauclain spoke from the standpoint of the locomotive builder, and urged the importance of securing the best nickel steel. The processes had been improved and there was no reason for hesitating in using this material if made by the best makers. Mr. Quayle asked for information as to the heating of nickel steel axles. Mr. Gillis mentioned the fact that this material was considered by the Navy Department as beyond experiment in this respect. Nickel steel has long been used for marine shafts running at high rates of speed. Mr. Pomeroy also pointed to the necessity for getting the best nickel steel. Those who were disappointed in the results obtained when they expect to repeat the experience of naval service had probably not obtained the quality of steel used in that service. It was made clear that the process of manufacture of nickel steel was very important and that only the best should be used.

### REPORTS.

"The Extent to Which the Recommendations of the Association have been put into Practice."

This was an elaborate and painstaking review of the entire records of the Association, and included an index of the proceedings and a valuable summary of the large number of recommendations made from the beginning. There was no discussion.

### Relative Merits of Cast-Iron and Steel-Tired Wheels.

The committee had not been able to get data of any value

from the members. Only two had replied to the committee's circular this year. The committee was continued. Mr. Rhodes explained his confidence in cast-iron wheels. The greatest danger of breakage of cast-iron wheels formerly was largely due to the heating effect of the brake shoes. The use of the thermal test had the effect of improving the character of the wheels, and this had practically placed the wheels beside steel wheels in safety. At first there was difficulty in securing wheels to meet the thermal test. They had since been made to meet it. The application of brakes necessitated the use of this test, and Mr. Rhodes stated that in two years' experience with the thermal test he had not known of a single case of cracking in the plate. He clearly put himself on record as favoring the cast-iron wheel under the thermal test as being safer than some steel wheels. In short, the cast-iron wheel had been improved more than some of the steel-tired wheels.

### Ton-Mile Basis for Motive Power Statistics.

The discussion of this subject developed the fact that there were not only differences of opinion among the members, but also among those of the committee, as to whether the weight of the engine should be included in the weight of the train, or whether the records should be stated in the weight of the trains behind the tender. Messrs. Henderson, Marshall and Deems took the view that the comparison should be made on the basis of the load back of the tender. Mr. Marshall directed attention to the desirability of stating the mileage statistics as well as the ton mileage, because of the fact that there are important expenses which depend on the engine mileage quite independently of the ton mileage. For these, which include certain round house expenses, the ton mileage comparison would be misleading. He thought that if switching statistics are kept on the ton-mileage basis at all, they should be prepared with reference to the total tonnage handled on the division. Mr. Delano called attention to the well-known fact that the ton-mile as a unit did not always mean the same thing. He thought that the work of reform in the subject of comparison of statistics was progressing, but much patience was required to bring about the necessary improvement in this very important matter. He emphasized particularly the necessity for making the units more reliable in order to give fair measurements. Whether or not the weight of the engine was included in that of the train, the really important thing was to account for the light mileage. Mr. Rhodes urged improvement in the methods of measuring the work of the men, because carelessness in this respect destroyed their confidence in the fairness of the comparison.

Throughout the entire discussion it was indicated that many of the members felt that light engine mileage would probably take care of itself, and the really vital point in the entire treatment of the subject was introduced by Mr. Deems, who favored the greatest simplicity of the statistics, even if it interfered somewhat with their accuracy, for the sake of getting the returns promptly. Figures brought out at the middle of the month were more valuable than more elaborate and more accurate figures brought out at the end of the month. The Association did not appear to consider it important to attempt to show the differences due to the differences in designs of engines in the statistics, such as those improvements which give high tractive power in proportion to the weight of the engines.

### Flanged Tires.

The report of the Committee on Flanged Tires, which is one supplementing the report of last year, was read by Mr. S. Higgins, Chairman of the committee. The original report was made on 10-wheel locomotives only, while this, the second report, covers mogul, 10-wheel and consolidation locomotives. Nearly all of the roads have experimented with all flanged tires, and a number of the important roads report their use on their mogul, 10-wheel and consolidation engines. The Burlington road two years ago placed flanged tires on all of the wheels of the mogul engines of a certain division of the road, and Mr. Deems reports that the tires last fully twice as long without turning. The point brought out by Mr. Hawksworth was of a very interesting nature, as the road with which he is connected has 16-degree curves and 3 per cent. grades. The rails of the track were laid on soft-pine ties, no tie-plates being used. They experienced a great deal of trouble with blind tires and also a great deal of difficulty in running the engines with the drivers all flanged. It was impossible to keep the track in gauge, and for a short time these engines were laid off. Finally, the second pair of wheels were taken out and blind tires 2 in. wide were put in to prevent the engine from getting off the track.

Mr. Delano believed that the flanging of the wheels of mogul and consolidation engines is done at the expense of the track, for on some sharp curves inside rails are necessary to keep up the blind tires as they slide over the main rail. On such engines, with all wheels flanged, there must necessarily be some severe strains set up in the rails. Another method to diminish flange wear, without injury to the track, Mr. Delano believes to be that of making either a single or double truck do more of the guiding of the engine instead of throwing it on the first pair of drivers. One division of the road with which he is connected has ten 10-wheel engines, the double truck being equipped with a center pin. The front drivers of the engines are blind and the rear two flanged. These engines are running in fast passenger service and take the sharpest of curves very smoothly.

The Central Railroad of New Jersey has 25 heavy consolidation locomotives weighing 205,000 lbs. These engines, Mr. McIntosh says, have been in constant service for over a year. The wheels are all flanged, and are giving the best of service.

Mr. Vauclain, in giving his views on the subject, from the standpoint of the manufacturer, said: "It seems to me that the conclusions of the committee are all right. If you take a consolidation locomotive having a 16-ft. wheel base and place it on a 20-degree curve, you find that the height of an arc in a 16-ft. chord is about 1.35 in. If the track is put down ¼ in. wide, ¾ in. play, 4 ft. 8½ in. gauge, you have 1 in. of the 1.35 in. already taken off by simple measurements. We have .35 in. to provide for, supposing your driving wheel would come exactly in the center. But your driving wheel does not come in the center of the arc, but the two center wheels are spaced on either side of the center. The distance from the tire to the track at that point would probably be about 3/16 in. less, with a lost motion between the hubs of the driving wheels and the box of 1/16 in. on the side.

"I think it is perfectly safe to work upon for all locomotives of modern design up to curves of 20 degrees. We have been building hundreds of locomotives for all ordinary railroad practice in the past four years with as large a wheel base as 16 ft. 4 in., and having all wheels with flanged tires. I think that the guard rails, frogs, switches, etc., can be safely arranged for engines with large wheel base."

Mr. Quayle had been testing flanges on all driving wheels during the past year on his engines in the switching yards at "battle ground," Chicago, where they have experienced the most trouble with flange wear, and it has reduced this trouble very much, and he favored the practice of flanging all driving wheels. It seems to be the consensus of opinion that if the locomotive is adjusted properly, with the right amount of clearance, and if the track is of the proper elevation and gauge, the flange wear will be diminished by this practice.

### Compound Locomotives.

Mr. Vauclain took exception to the first conclusion of the committee, which was that "compound locomotives have not yet come into general use in America, but are gradually emerging from the experimental stage." This, he declared, should be erased from the report. We are constantly making changes in design of the simple engine and do not consider it in the experimental stage; we therefore have no right to say that the compound is not past its experimental stage. While compounds

have not been generally adopted by the railroads of this country, they are coming rapidly into use for both freight and passenger service. This is evident from the figures given by Mr. Vauclain to the effect that 50 per cent. of the locomotives built by the Baldwin Works are of the compound type. The Society of Engineers in Russia had decided that the 4-cylinder compound is an acceptable locomotive for the Russian Government, and they had been building 2-cylinder compounds for a number of years. Mr. Délano was of the opinion that the compound locomotive is in an experimental stage on some roads, but it could not be said to be in such a state on railroads that have from 25 to 150 of these locomotives in daily service. The Burlington road had not many compound locomotives, but with the two-cylinder compounds in freight service exceedingly good results are obtained. This road is so satisfied with them that they are going to order more. In the committee's conclusion No. 6 it states that there should be no difference in the size of drivers in the compounds and simple engines in the same service. It is believed that slow piston speed is to be sought for in all engines, but are there not good points in favor of larger drivers on the compound as compared with the simple engines? Mr. Deems' reply to this conclusion No. 6 was that the report was based entirely on the replies received from the circulars sent out, which show reports from 15 members that there is no difference in size between the drivers, and one reports a slightly larger wheel for both freight and passenger service.

Prof. Goss, in supplementing Mr. Vauclain's remarks, said that there is a sense in which we may consider all locomotives in an experimental state. The process of increasing weight of locomotives from 100,000 to 250,000 lbs. involved a great deal of experimenting. It will be well to bear in mind that the compound engine is a more perfect machine as it stands to-day in this country than in any other. The process of compounding has gone ahead of that of any other country. An important point was brought out by Mr. Gibbs that was not touched upon by the committee; that of the maximum possible weight on drivers, the maximum boiler capacity which is limited by weight on the drivers. It has been demonstrated that the compound locomotive can save from 15 to 20 per cent. in fuel. This means a very much better use of heating surface. We are going to get more out of a given weight in a compound than for the same weight in a simple engine.

The remarks of Mr. Sague brought up the impossibility of making the reciprocating parts of compound locomotives as light as those of simple locomotives. There has been a tendency to reduce to a minimum the weight of pistons, crossheads and piston rods for the purpose of diminishing the reciprocating counterbalance on the track, and builders have not sufficiently considered this with the compound. It is said that a single compound locomotive among a number of simple locomotives has the unfavorable position. His experience had been rather different from this. The pooling system was used on a compound, and a lot of 18 simple locomotives which were recently built, and the results of the compound were so favorable that the men tried to get the compound in preference to the simple engines.

Mr. Sague believed that there was no reason to consider the two-cylinder compound as handicapped by clearances yet. It was a satisfactory engine for passenger service, but would not show as great advantage over the simple engine in passenger as in freight service.

There are many roads that are not using compound locomotives, and Mr. Waitt spoke with reference to the New York Central. The past experience and general sentiment against them in the past had caused a number of compounds to be changed over to simple engines. They also had some compound switchers which were not found entirely satisfactory in operating them as compounds. But the art seemed to be progressing rapidly, and he felt sure from the reports of the committee and the discussion that he had personally received a great deal of light, and had a very strong temptation to give such consideration to the compound as he had not given it before.

## TOPICAL DISCUSSION.

"Has the limit of length of tubes, two inches in diameter, been reached in locomotive practice?"

Mr. Vauclain says we have not reached the limit in length of 2-in. tubes, and prophesies that with the properly-designed engine we shall be using in the near future tubes 20 ft. in length. This was rather a bold statement to make, but when we consider that 15-ft. tubes are being used at the present time on the Chicago & Northwestern, 15 ft. 1 in. on the Fitchburg, 15 ft. on the Chicago, Rock Island & Pacific, and even 16 ft., as in the case of the Chicago, Burlington & Quincy, it does not seem improbable that the additional 4 ft. may be added in the future. The first question which would naturally present itself to those not having had experience with tubes as long as 15 ft. would be as to their vibration and the tendency to break loose at the tube sheets and cause leaky flues. This point was discussed by Messrs. Higgins, McIntosh, Brown and Quayle, who are using tubes of this length, and they are having no trouble with leaky flues. The limit of the length of tubes is determined by the tendency of the tubes to stop up and the probability of leakage. A tube when submerged in water has very little chance to vibrate as it is partly supported by the water. If brass and composition tubes 15 ft. in length have been used successfully, and give no trouble, there is reason to believe tubes 20 ft. in length will not.

### Metal Versus Wooden Cabs for Locomotives.

Mr. Sague of the Schenectady Locomotive Works opened the discussion by giving a few advantages of each. The most serious objection to metal cabs is undoubtedly that of increased weight, 900 to 1,300 lbs., and for some special cabs as much as 1,500 lbs. There is an increased first cost for metal cabs of $90 to $100 over those of wood. But the low cost of maintenance is a point in their favor, the paint will last a great deal longer on metal cabs, and in hot and moist climates the steel cab is almost necessary.

At this point in the proceedings a committee reported on the changes in the constitution recommended by the committee on "What Can the Association Do to Increase its Usefulness?" These changes and a number of the suggestions made in the report will come up for discussion next year. Mr. F. B. Miles was elected to honorary membership.

## REPORTS.

### Journal Bearings, Cylinder Metals and Lubrication.

This report was presented by Mr. W. C. Dallas, Chairman of the committee. The discussion was opened by Mr. G. H. Clamer of the Ajax Metal Company, who offered a brief but comprehensive statement concerning the place of lead in bearing-metal alloys. The requirements of bearing metals were classified as follows: 1. Least liability of heating. 2. Sufficient strength to prevent squeezing out under load, and high melting temperature. 3. Least abrasion in service. 4. Least possible abrasion of the journal. For journal bearings alloys of copper, tin, lead and zinc were generally used in the following groups: 1. White metals of tin, lead and zinc. 2. Bronzes of copper, tin and zinc. 3. Plastic bronzes, such as phosphor bronze, 4. Copper, tin and lead alloys. It was generally considered that hardness was necessary to secure good wearing qualities, but the speaker considered that a mistake, his point being proven by the wear of a 1/16-in. lead lining for 9 months without the lead being entirely worn out. The first and third possessed good frictional qualities. These qualities increased in proportion to the increase in the amount of lead which was properly combined in the alloy, and by adding a small amount of nickel the proportion of lead would be increased.

In the matter of cylinder iron Mr. F. M. Whyte spoke of favorable experience with false valve seats and cylinder bushings. Their value lay in the possibility of using metal for the

cylinders which was best adapted to prevent breakage, while the wearing surfaces could be made hard to increase their life.

Piston Valves.

The discussion was in all respects favorable to this type of valve, showing plainly that it had gained friends. It was spoken of as completely successful in principle, and its weak points were being strengthened through experiments and experience. The Burlington now has 65 engines with these valves and they are used on all new ones. On the Canadian Pacific some difficulty had been experienced with defective lubrication and wear of piston valves which had stems which were "off center." Mr. Delano spoke of the interesting feature of solid piston valves with central steam admission which caused them to run away from the steam. The pressure of the exhaust steam coming on the ends of the valve alternately caused it to move in the direction of motion of the valve stem. No serious objection was raised to this action, but it is believed that the simple remedy which has been applied, of making the valve hollow, had the disadvantage of bringing cold exhaust steam too close to the hot entering steam.

Prof. Goss mentioned the saving of power by reduced internal resistance of the engines as a secondary matter in view of the serious distortion of the steam distribution with the slide valve which was caused by high resistance to the movement of the valve.

Those who have designed valve motions for piston valves with central admission have discovered the peculiar effect upon the equalization of the cut-off of attempts to secure direct motions by reversing the usual positions of the eccentrics. Mr. Henderson mentioned this. Central admission required direct motion without the reversal of the motion by the usual rocker shaft, and if the eccentrics are changed instead of rebuilding the valve motion with the omission of the rocker, the distribution will be seriously distorted.

Spring rings were considered by Mr. Henderson to possess advantages over other forms of packing rings for piston valves. He believed that it was necessary to provide packing which will adapt itself to the bore of the valve bushings when they become worn larger at the center of the range of motion of the valve, where the wear is greatest. He did not think that rigid rings would be as satisfactory because they would not accommodate themselves to the enlargement of the bushings due to the increased wear over the range of short cut-offs where most of the wear comes.

Power Transmission by Shafting vs. Electricity.

This report is generally considered the best brought before the convention. We think it the ablest paper on electrical distribution for shop purposes that has appeared anywhere. Some disappointment was expressed privately that there were not more data as to the amount of power required to operate individual machines, but the purpose of the committee was to treat the subject in a much broader way. Many have looked to electrical distribution for a reduction in fuel bills, and while this is justified, the real function of such distribution is in the improvement of shop methods which increase output, permit of saving in labor, and improve the general convenience of operation. The Baldwin Locomotive Works began to decrease their laboring forces at once when motors were put in, and this was the most important result. We print this report nearly in full, and earnestly commend it to our readers. It offers reasons why they should consider electric motor driving and it presents valuable practical suggestions, based upon wide experience, as to the selection of systems to suit their conditions. This report is given first place among those of the Master Mechanics' Association in this issue. The discussion was somewhat disappointing, although it was clear that the impression desired by the committee was made, to the effect that electric driving made it possible to effect a much needed revolution in shop methods, and that it was this business improvement which should make electrical systems attractive. While the report did not say so in words, it is sufficiently apparent that the present wonderful capacity of the Baldwin Works, with their cramped location, is chiefly due to the excellent use which is made of motor driving.

In the discussion the question of voltage came up. While 500 volts meant economy in wiring, 220 volts gave better results in the motors, and the lower voltage led to better care of the brushes of the motors. With the higher voltage the tendency was to defer attention to the motors. The current, while not dangerous, was such as to cause some inconvenience. Mr. A. L. Rohrer (General Electric Company) spoke of the advantages of direct current over the alternating induction motor because of the speed control. Voltage was largely a question of conditions, but probably about 250 volts was best adapted to railroad shops. The value of "taking the tool to the work" was made prominent, and also that of the possibility of measuring, with an ammeter on a shop tool, the amount of power required for various kinds of work.

Best Type of Boiler for Shop Purposes.

This report did not bring out the amount of discussion that was expected. It probably will, however, have the effect of directing attention to the desirability of giving more attention to shop steam plants.

TOPICAL DISCUSSIONS.

How to Make Pooling of Locomotives a Success.

Mr. G. W. Rhodes presented in his characteristic way the principle of pooling as illustrated by the livery stable business. He did not appear to favor pooling, but if it is necessary in order to get more work out of the engines he would put back into the care of the engines the money saved in interest on the amount of invested capital which was avoided by pooling. Mr. Henderson showed it to be advantageous to wear locomotive tires out rapidly in, say ten years, because in that time they were obsolete anyway. It was apparent that many did not believe in pooling, but everybody seems to be trying, by means of double crewing or pooling, to get more mileage out of engines. In time-freight service on the Chicago & Northwestern it had been found satisfactory to put three crews on each engine, whereby 404 miles per day were obtained. With this method the mileage was sufficient and the responsibility for the care of the engines was placed on regular men as it could not be in pooling. We should say that the adverse criticisms of the speakers on pooling were directed against abuses of the system and neglect to look after the repairs rather than the principles of pooling.

Graphite As a Locomotive Lubricant.

Mr. G. R. Henderson opened this discussion. Graphite was believed to be a good lubricant but it had been found difficult to get it upon the bearings.

Closing Business.

After receiving the report of the committee on subjects for next year the following officers were elected: President, Mr. W. S. Morris; First Vice-President, Mr. A. M. Waitt; Second Vice-President, J. N. Barr; Third Vice-President, G. W. West; Treasurer, Angus Sinclair.

---

The Department of Mechanical Engineering at Purdue University formally dedicated on May 28th a 2,000,000-gallon water works pumping engine recently presented to the laboratory by the City of LaFayette. This pumping engine was built by the Clapp & Jones Manufacturing Company of Hudson, New York, in 1875, and is a fine example of a duplex walking-beam pump. As installed in the laboratory it will serve as an example of this type of pumping engine, and in addition to its historical value, will furnish an ample supply of water for hydraulic experiments.

---

The washing of oily waste at the stations of the Chicago Edison Company is highly profitable. From 100 lbs. of oily waste about 40 lbs. of clean waste and 40 lbs. of oil are recovered. The waste is put through a washer consisting of a train of rolls over which a stream of hot water is running. This extracts nearly all of the oil and much of the dirt. The oil and water are caught in a receptacle, the oil separated and passed to an oil purifier and the waste put into a drier. The oil is purified by settling and boiling. A complete account of this and other operating economies in central-station practice was given in a paper by Mr. W. L. Abbott, read before the National Electric Light Association recently.

## LOCOMOTIVE TENDERS.

### Several Examples of Improved Practice.

By William Forsyth.

(Concluded from page 184.)

### Pennsylvania Six-Wheel Tender for Class E 1 Engines.

Another example of six-wheel tender for fast passenger service is shown in Figs. 9 and 10, which represent the tender of the Pennsylvania Railroad class E 1 engine, which was fully illustrated and described in our June issue. In this case the middle and rear axles are equalized. The tank carries the coal above the water and holds 4,000 gallons. The coal runs down to the fireman at an elevation about one foot above the foot plate, which is convenient in view of the high fire doors. The usual wooden flooring on top of the frames is omitted in this design.

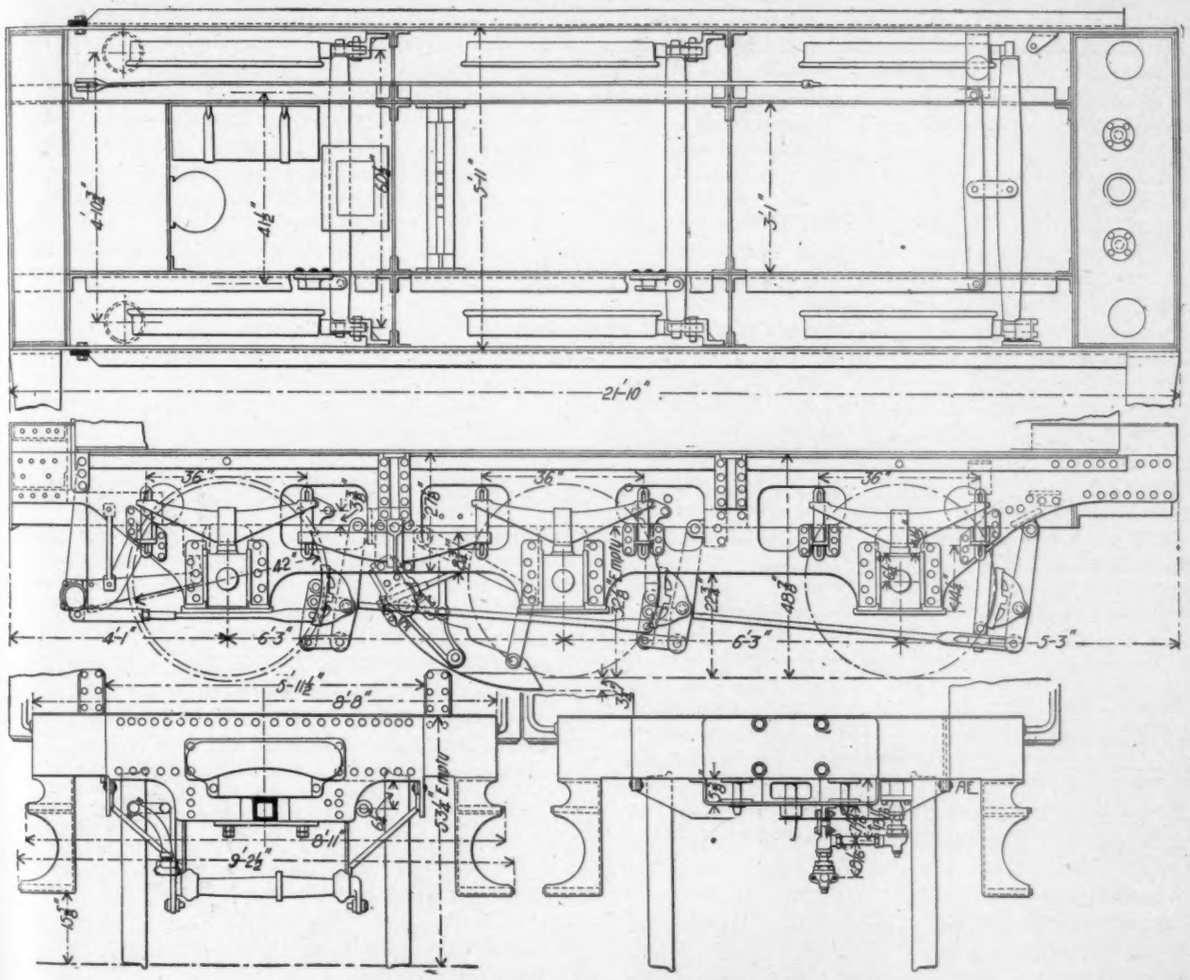



Fig. 9.—Frame for Six-Wheel Tender Pennsylvania Railroad.

The main frames are outside of the wheels and the boxes are carried in bracketed pedestals bolted to these frames. The main frames carry an internal cellular system with longitudinal stiffening plates and cross girths which attach to the main frames between the wheels. The tank rests between box girders projecting above the frames at the front and rear ends, the front one being much deeper than the one at the rear. The tank is wedged tightly in place and is held by special fastenings riveted to it and to the frames, the purpose being to hold the tank in case of collision, so that it will not be torn loose by the shock and endanger the lives of the engineer and fireman. This is in marked contrast with the usual ineffective fastenings, and the practice is suggestive of a necessary improvement in tank fastenings. The brake cylinder is at the rear and vertical. It operates a bell crank with two arms projecting vertically downward to the equalized brake system. Another arm takes the hand brake connection. In the front end of the tank structure four closets are built for clothes, tools and the steam pump used in connection with the steam heating system for the train. The water space bracing consists of 2½ by 2½ by 5/16-in. angles, spaced 2 ft. 10 in. apart, and connected across by 6-in. plates. This tender has an excellent arrangement of draft gear in which the drawbar has 1⅞-in. lateral play each way from the center. The design employs iron and steel throughout and is made to receive the Janney coupler. The buffer is a plain two-stem plate with springs which are not equalized with the coupler, and the guides for the follower and buffer are steel castings. The buffer and draft springs are enclosed in metal boxing, the whole arrangement being the most durable that we have seen.

These tenders are supplied with the form of balanced track tank scoop which was fully illustrated on page 283 of this paper in November, 1896, and the fact that the same drawings were used for the scoops of the class E 1 engines testifies to the attention this road gives to designing. The experience of four years has not developed a single desirable improvement in this detail. The interesting feature of the scoop is the balancing of the lower part so that it may be raised from the trough at high speed. It has been demonstrated that water may be taken at speeds of 70 miles per hour. Experiments indicate that 3,000 gallons may be taken in 10 seconds at a speed

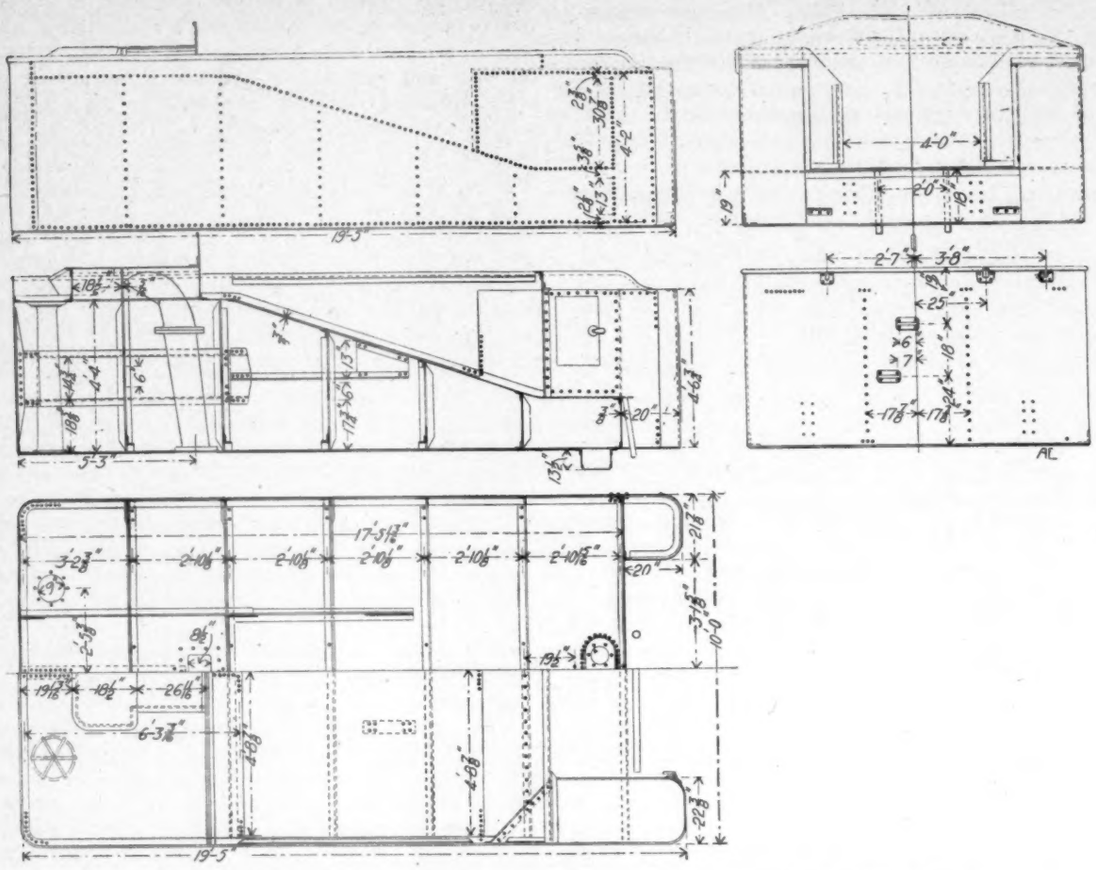


Fig. 10.—Sectional Views of Tender Tank for Class E 1 Engines, Pennsylvania Railroad.

of 68 miles per hour. The following figures have been supplied from tests made with one of these tenders:

| Time in seconds. | Speed in m. p. h. | Gallons water taken. | Dip of scoop in water. |
|---|---|---|---|
| 20 | 34 | 1,760 | 3⅛ in. |
| 17 | 40 | 2,315 | 3 in. |
| 14 | 49 | 2,380 | 3⅛ in. |
| 11 | 62 | 2,608 | 3 in. |

These figures show that more water was raised per foot of trough at the higher than at the lower speeds, which is accounted for by the form of the opening which takes in the wave raised by the scoop and adds to the depth of water taken. These tests indicate that there should be no difficulty in picking up 3,000 gallons from a tank 400 yards long at speeds of 60 miles per hour.

---

An Atlantic liner, larger than any now afloat, has been ordered by the North German Lloyd, to be built by the Vulcan Shipbuilding Company of Stettin, Germany. It is rumored that her length will be 752 ft., her speed 24 knots, and that her engines will develop 40,000 h.-p.

---

A lathe, direct driven by an electric motor, turning up a piece of shafting while the whole combination was suspended from an electric traveling crane, was exhibited to a party of engineers visiting the Crocker-Wheeler Electric Company's works recently. This ingenious application of electricity to machine tools was devised to exhibit the flexibility of the electric method of power distribution and was described in "The Mechanical Engineer." The lathe had a motor direct connected to the spindle and the piece of shafting was placed in the centers. The electric current was applied by a cable connected to the traveling crane. The current was applied, the lathe started on the floor and then lifted by the crane and carried up and down the shop while turning up the shaft.

## THE FUTURE USEFULNESS OF THE MASTER MECHANICS' ASSOCIATION.

By M. N. Forney.

It is very difficult for an old newspaper man to lay off the spirit of cock-sure criticism. The habit of assuming for years that he is very wise and very right in his opinions cannot be laid aside when his editorial pencil has been blunted, and when he no longer has the right to speak of himself as "we." Annual conventions like those which have just been held in Saratoga are incentives to be oracular, they excite criticism and stimulate the feeling common to most of us, that we know just a little better than others how such affairs should be conducted. If besides the conventions of this year a person can go back for thirty years and recall the meeting held in Philadelphia in 1870, and nearly all since then, it is a still further incentive to criticism and suggestion.

The fact that a committee was appointed to report on the question of "What Can the Master Mechanics' Association Do to Increase its Usefulness?" naturally suggests two questions, what have been the hindrances to the usefulness in the past and what would aid in increasing it in the future? The retrospect of thirty years will be a help in replying to the first part of the inquiry, and it suggests two causes which during that time have seriously interfered with the usefulness of the meetings. The first of them is meeting rooms in which only part of the proceedings could be heard, owing to noise or bad acoustic properties, or an arrangement of seats by which the audience and the speaker have been separated too far from each other. To hold meetings for discussion at which the speakers cannot be heard seems like great folly; nevertheless, it has happened at many of these meetings held during the past thirty years that a great part of the proceedings were inaudible to many of those who attended them. To increase their use-

fulness, therefore, it is important first to secure a good room to meet in, which should not be too large, and in which not only speakers on the platform can be heard by the audience, but those in the auditorium can be heard by the whole house. The people and hotel proprietors of Saratoga seem to be anxious to induce not only the Master Mechanics' and Master Car Builders' to hold their meetings there every year, but they also want to induce other associations to do the same thing. There is hardly anything which would do so much to attract such organizations to meet there as a really good room would if it was well adapted for such meetings. It should not be too large—a seating capacity of three or four hundred would be sufficient—and it should be located where there would be little or no external noise, as from the street. In the middle of Congress Spring Park would be an ideal place for it. The seats should be arranged in the form of a horseshoe around a central platform and on an inclined floor as in a theatre, so that the people in the audience would be brought into close relation to the chairman and to each other. There should be two small committee rooms. The ceiling should not be too high on account of acoustic properties. Such a room would be a great boon to associations whose meetings are attended by a comparatively small number of people. The Convention Hall in Saratoga is entirely too large for such audiences, and the voices of their speakers are lost in it. Will the people of Saratoga respond to this demand? There is a disposition to hold the meetings of the two railroad associations there every year. A really good meeting room would add very much to the inducements to take them there.

In speaking of the second hindrance to the usefulness of these associations, a disavowal is made of any personal reference to any one. What will be said is the result of historical reminiscence, extending backward thirty years, and candor compels the remark that during that time the presidents of the associations, as presiding officers, have been good, bad and indifferent. The good ones have been few, the bad and indifferent ones many. In other words the proceedings and the work of the associations has been very much hindered by having inexperienced presiding officers. Some of us can recall occasions when the proceedings were snarled into such an inextricable tangle that the work came to a standstill. That those who preside should not be very efficient in such duties is not to be wondered at, very few of the members have ever had any experience as presiding officers. The presidents are not chosen with reference to their capacity for such duties, but they are elected to the office as a recognition of merits which are of quite a different kind, and they are elevated to the office as an honor, and the position is so regarded. Now, it is of as much relative importance that meetings of this kind should be under efficient and intelligent control as that a regiment in going into action should be directed by a competent commander, or that a locomotive in running an express train should be in charge of skillful runners. Amateurs and inexperienced people are not intrusted with such duties and there is quite as good reason for not placing the conduct of such meetings of this kind under the control of persons who know little of parliamentary proceedings, or who have not the knowledge and tact to call out what is best in the minds of the auditors.

These considerations lead to the suggestion of separating to some extent the honors of the president and the duties of the presiding officer. Honor the member by electing him president and then let the Executive Committee appoint an assistant to that officer who would be selected solely with reference to his capacity as a presiding officer. The president would then open the meeting, deliver the annual address and perform like duties, but his assistant could at any time take his place as presiding officer, and that would leave the president free to attend to other important duties during the session, instead of, as now, tying him down in the chair all the time. There are many things which could profitably be attended to by the president during the session, such as seeing committees, aiding and directing the preparation of reports, shaping in different ways the work and policy of the Association, etc. If it was desired to accentuate the honor, a suitable badge could be provided and a title conferred.

In the light of past experience it is safe to say that the usefulness of the meetings would be immensely increased if they were presided over by thoroughly efficient chairmen.

Another suggestion presents itself. The purpose of the reports made to these meetings and the discussions thereon is to elicit from the members as much information as possible in relation to the subjects which are brought up for consideration. The method of doing this is by circulars of inquiry, and then when the matter comes before the meetings by a general discussion. While these methods accomplish their purpose, to a certain extent, it is thought that a much more effective way of getting at the knowledge of other people is by an interview and questioning them with reference to the subject under consideration. It is the method adopted in courts of justice, in the investigations of committees of various kinds and in our daily life and intercourse with other people. The suggestion is that the various committees of investigation should, during the session of the convention, invite different members to appear before them to confer about the question at issue, and in that way give the members of the committee an opportunity to question those who are thus invited. That is the method we all adopt when we want to get information relating to any matter, and it would seem as though it would be equally efficacious in the investigation of committees.

The question of indexing the reports of the Association was brought up, and acted upon, and the committee was authorized to have a comprehensive index made of all the reports of the Association up to date, which will certainly increase their value very much. The past volumes have very poor indexes, and it would be very desirable to take some action which would secure better ones in the current volumes in the future.

One of the great difficulties at the meetings of these associations, which are now attended by from 1,500 to 1,800 people, to remember the names of those who are there and identify them on sight. The method adopted by the American Society of Mechanical Engineers at their meetings is a very good one. A list of the members in attendance is prepared and numbered. Numbered badges are then provided for the members, and the list and numbers are printed and copies distributed so that in meeting a person his number is a clue to his name. It facilitates intercourse very much and promotes sociability.

Of course, after all the reports of committees the discussions at the meetings and, in fact, the value of the whole proceedings, depends very largely on the persons who contribute to them. The problem is to call out what is best among the members and suppress the vapid talkers—not always an easy task. If all the members were intelligent and wise, of course the meetings would be more profitable and interesting. Inasmuch as the membership consists of many grades of intelligence and fatuity the problem is to get the best that is possible out of the material and the people who come annually to these assemblages.

---

Mr. A. L. Humphrey, Superintendent of Motive Power of the Colorado Midland, has been appointed to a like office on the Colorado & Southern, vice John Foster, resigned. Mr. Humphrey has been Superintendent of Motive Power of the Colorado Midland since January, 1893, and was formerly for five years Master Mechanic of the same road.

---

Mr. C. W. Whiting, Mechanical Engineer of the E. P. Allis Company, Milwaukee, Wis., has been appointed Mechanical Engineer of the Chicago, Milwaukee & St. Paul at West Milwaukee, Wis. Mr. Whiting is 37 years of age, is a graduate of Stevens Institute in the class of 1884, and has since been draftsman with the Philadelphia & Reading Coal and Iron Company at Pottsville, Pa.; has held the responsible position of Inspector and Engineer of Tests, Chief Draftsman, Superintendent and Mechanical Engineer with various firms.


**Another Monster Freight Locomotive; Pittsburgh, Bessemer & Lake Erie Railroad.**

E. B. GILBERT, *Master Mechani* . PITTSBURGH LOCOMOTIVE WORKS, *Builders.*

## ANOTHER MONSTER CONSOLIDATION LOCOMOTIVE.

Pittsburg, Bessemer & Lake Erie R. R.

Built by the Pittsburg Locomotive Works.

This locomotive surpasses in weight and tractive power all locomotives ever built and its remarkable dimensions are given in the accompanying table. The information reaches us too late for extended comment, but this is not necessary to those who will compare it with the large engines referred to in the table on page 316 of our issue of October of last year. These engines are remarkably heavy and are large in every way, except in grate area, as the table of detail dimensions indicates. Two of these engines have been built by the Pittsburg Locomotive Works and are now in service. It now seems impossible that these dimensions will be exceeded, but the progress of the past two years has been so remarkable in this direction that we shall not prophesy as to the future. An 84-in. boiler, 220 lbs. steam pressure and 24 by 32 in.-cylinder certainly constitute an impressive combination, the effect of which is seen in the immense tractive power of 63,000 lbs. The chief dimensions, including those of the very large tender, are as follows:

### General Description.

| | |
|---|---|
| Gauge of track | 4 ft. 8½ in. |
| Kind of fuel used | Bituminous coal |
| Weight on drivers | 225,200 lbs. |
| Weight on truck wheels | 25,100 lbs. |
| Weight, total | 250,300 lbs. |
| Weight of tender, loaded | 141,100 lbs. |
| Weight, total of engine and tender | 391,400 lbs. |

### Dimensions.

| | |
|---|---|
| Wheel base, total of engine | 24 ft. 4 in. |
| Wheel base, driving | 15 ft. 7 in. |
| Wheel base, total of engine and tender | 57 ft. 11¾ in. |
| Length over all, engine | 41 ft. 1½ in. |
| Length over all, total, engine and tender | 68 ft. 0 in. |
| Height, center of boiler above rails | 9 ft. 8 in. |
| Height of stack above rails | 16 ft. 0 in. |
| Heating surface, firebox | 241 sq. ft. |
| Heating surface, tubes | 3,564 sq. ft. |
| Heating surface, total | 3,805 sq. ft. |
| Grate area | 36.8 sq. ft. |

### Wheels and Journals.

| | |
|---|---|
| Drivers, diameter | 54 in. |
| Drivers, material; front, intermediate and back centers | Steeled cast iron |
| Drivers, material, main centers | Cast steel |
| Truck wheels, diameter | 30 in. |
| Journals, driving, front, intermediate and back | 9 by 13 in. |
| Journals, driving, main | 10 by 13 in. |
| Journals, engine truck | 6 by 12 in. |
| Main crank pin, size | 7½ by 8 in. |

### Cylinders.

| | |
|---|---|
| Cylinders, diameter | 24 in. |
| Pistons, stroke | 32 in. |
| Piston rods, diameter | 4½ in. |
| Piston rod and valve stem packing | Metallic |
| Main rod, length, center to center | 118⅝ in. |
| Steam ports, length | 20 in. |
| Steam ports, width | 1⅝ in. |
| Exhaust ports, length | 20 in. |
| Exhaust ports, width | 2¼ in. |
| Bridge, width | 1½ in. |

### Valves.

| | |
|---|---|
| Valves | Balanced |
| Valves, greatest travel | 8 in. |
| Valves, outside lap | 1 in. |
| Valves, inside lap or clearance | 0 in. |
| Valves, lead in full gear | 1-10 in. |

### Boiler.

| | |
|---|---|
| Boiler, type of | Straight with sloping back end |
| Boiler, water test | 330 lbs. |
| Boiler, steam test | 240 lbs. |
| Boiler, working pressure | 220 lbs. |
| Boiler, material in barrel | Carnegie steel |
| Boiler, material in barrel, thickness | 1 in. |
| Boiler, diameter of barrel at front sheet | 84 in. |
| Boiler, diameter of barrel at throat sheet | 88 in. |
| Boiler, diameter of barrel at back head | 81½ in. |
| Seams, kind of | Horizontal, butt joint, double welted sextuple riveted |
| Seams, kind of | Circumferential, double riveted |
| Thickness of tube sheet | ⅝ in. |
| Dome, diameter | 32 in. |
| Safety valves | Two 3-in. open pops and one muffler |
| Water supplied through | Two No. 12 injectors |
| Crown sheet supported by | Radial stays |

### Tubes.

| | |
|---|---|
| Tubes, number | 406 |
| Tubes, diameter outside | 2¼ in. |
| Tubes, length over tube sheets | 15 ft. 0 in. |
| Tubes, material | Solid drawn steel |

### Firebox.

| | |
|---|---|
| Firebox, length | 132 in. |
| Firebox, width | 40¼ in. |
| Firebox, depth at front end | 82⅞ in. |
| Firebox, depth at back end | 70⅞ in. |
| Firebox, material | Carnegie firebox steel |
| Firebox, thickness of sheets, crown | 7-16 in. |
| Firebox, thickness of sheets, sides and back | ⅜ in. |
| Firebox, thickness of sheets, tube | ½ in. |
| Firebox, water space, width | front 4 in., back 4 in., sides 4 in. |
| Grates | Cast iron, rocking pattern |

**Smokebox.**

| | |
|---|---|
| Smokebox, diameter | 83¼ in. |
| Smokebox, length from tube sheet to end | 68⅝ in. |

**Other Parts.**

| | |
|---|---|
| Exhaust nozzle | Single |
| Exhaust nozzle, diameter | 5¾ in. |
| Smoke stack | Taper |
| Smoke stack, least diameter | 17 in. |
| Smoke stack, greatest diameter | 18 in. |
| Smoke stack, height above smoke box | 33 in. |
| Track sander | Pneumatic |
| Power brakes | Westinghouse American |

**Tender.**

| | |
|---|---|
| Type | Eight-wheeled, with swivel trucks |
| Tank capacity, water | 7,500 gal. |
| Tank capacity, coal | 14 tons |
| Kind of material in tank | Steel |
| Type of under frame | Steel channels |
| Type of truck | Diamond |
| Type of truck springs | Double elliptic |
| Diameter of truck wheels | 33 in. |
| Diameter and length of axle journal | 5½x10 in. |
| Distance between centers of journals | 77 in. |
| Diameter of wheel fit on axle | 6⅞ in. |
| Diameter of center of axle | 5⅞ in. |
| Length of tender frame over bumpers | 25 ft. 0 in. |
| Length of tank | 23 ft. 6½ in. |
| Width of tank | 9 ft. 10½ in. |
| Height of tank, not including collar | 65 in. |
| Height of tank, including collar | 81 in. |
| Type of back drawhead | M. C. B. coupler and Westinghonse friction draft gear |

A table with some interesting comparative figures, including these engines, is given below:

| Railroad | P. B. & L. E. | Union R. R. | Illinois Central. | Lehigh Valley. |
|---|---|---|---|---|
| Builders | Pitts-burgh. | Pitts-burgh. | Brooks | Baldwin. |
| Size of cylinders | 24 x 32 in. | 23 x 32 in. | 23 x 30 in. | 18 & 30 x 30 in. |
| Total weight | 220,300 lbs. | 230,000 lbs. | 232,200 lbs. | 225,082 lbs. |
| Weight on drivers. | 225 200 " | 208,000 " | 193,200 " | 202,232 " |
| Total weight of engine and tender | 391,400 " | 334,000 " | 364,900 " | 346,000 " |
| Tractive pow. r based on 25% of adhesive weight | 56,300 " | 52,000 " | 48 300 " | 50,558 " |
| Net hauling capacity on level | 7 847 tons. | 7,261 tons. | 6,717 tons. | 7.049 tons. |
| Comparison of hauling capacity | 100% | 92 5% | 85.6% | 89.8% |

## MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

This society opened its 41st meeting in Cincinnati, May 15. The first professional paper, by H. T. Yaryan, dealt with hot-water heating from a central electric light station and began with the remark that "it does not require the eye of a prophet to foresee the future means of heating and lighting our cities." It gave a good description of a system now in use in a number of cities whereby the by-product sale of heat in the form of hot water was satisfactorily profitable. Water at a temperature not over 212 degrees was circulated in pipes at a pressure of 60 or 70 lbs. The details were fully presented, also the advantages of hot water over steam circulation. The demand for heat was so much greater than that for light that electricity was really the by-product. Experience had shown that every dwelling house heated required the exhaust from engines necessary to light four. The paper describes an apparently practicable and successful system.

Systems and efficiency of electric transmission in shops were discussed in a paper by William S. Aldrich, which compared various power transmission systems and made clear the advantages of scope in electric systems. The induction motor received the following endorsement:

"The induction machine as it stands to-day is probably the most perfect motor yet developed from the standpoint of electric transmission in factories and mills. It may be started and operated from any point, at any time, at practically any load and speed within its predetermined ranges. It will permit of higher lineal speeds than are possible with any other type and cannot be burned out from rough usage and overloads. This makes the induction motor specially fitted for driving almost all classes of shop machinery."

As a result of litigation in Massachusetts concerning damage claims for water privileges, Mr. George I. Rockwood at the previous meeting introduced the question of the proper method of computing the value of a horse-power, and as the discussion was not conclusive, it was reviewed at this meeting, but was again left without definite action. In a paper on the design of speed cones, Mr. James J. Quest offered a new method for obtaining the sizes of cone pulleys in which the "cut and try" process was elminated. Reheaters in multiple cylinder engines were shown in a paper by Dr. Thurston to be the means of securing a small gain, but the author stated that "unless the reheater is made effective in superheating, it is better not to employ it at all."

A six-day test on a 15,000,000 high-duty Nordberg pumping engine was recorded in a paper by Messrs. Cooley, Wagner and Allen, in which the average steam consumption for the six days' run was 12.7 lbs. per horse-power hour. This paper was followed by one by Prof. Goss describing his noteworthy tests of the Snow pumping engine of the Indianapolis Water Company, conducted in 1898. This engine had, at the time of the test, the best record for economy.

Superheaters have been improved so much during the past few years as to justify the expectation that they will constitute one of the leading factors in the improvement of steam engine economy in the immediate future. An application to a Worthington pump at the water works of St. Albans, England, was described in Mr. E. H. Foster's paper. This plant was not a refined, up-to-date establishment, but an ordinary Worthington "low duty" installation, with two Lancashire boilers of the two-flue type, each boiler having a Schwoerer superheater with 60 sq. ft. of external heating surface. The piping was arranged to use or cut out the superheaters at will. The pumps indicated about 100 horse-power in the tests, and the advantage in duty between saturated steam and steam superheated to 125 degrees was about 16 per cent. Corliss was shrewd in his use of superheated steam, and it is clear that years ago he appreciated its value.

Mr. B. C. Ball set many thinking about the question of "drop" in multiple-expansion engines by his paper on cylinder proportions for compound and triple-expansion engines. He favors "drop" and shows, we think, conclusively that it is desirable because of its effect in reduction in the proportion of internal condensation compared with the total amount of steam used, the condensation being nearly a fixed amount per stroke for given conditions, and by throwing away some work by free expansion at each end of the stroke a gain is found. This is because the total amount of work done is increased while the condensation, which is a total loss, becomes a smaller proportion of the steam used. The author agrees with Mr. George I. Rockwood in believing terminal drop beneficial, although this is contrary to the generally accepted opinion.

Of the remaining papers the most important were "Water Softening Plant at the Lorain Steel Company's Blast Furnaces," by N. O. Goldsmith; "The Automobile Wagon for Heavy Duty," and "Education of Machinist Foremen and Mechanical Engineers," by M. P. Higgins. We shall refer to the paper by Mr. Goldsmith in a future issue. The paper on automobiles brought out a marked preference for steam as a motive power for heavy wagons.

The attendance was good, but the discussions were very disappointing.

Mr. Henry W. Toothe, who has represented the Midvale Steel Company for the past eleven years and has been well and favorably known in the railroad supply business for twenty years, has severed his connection with that company and accepted the position of representative of the Chicago Pneumatic Tool Company, July 1, with headquarters in Denver. He will have charge of their interests in Colorado, Wyoming, Idaho and the mining districts generally and will bring to bear a very unusually wide acquaintance and valuable experience. We congratulate Mr. Toothe and the Chicago Pneumatic Tool Company upon this consummation. He is sure to enjoy a large measure of success, and we think that the company could not find a better representative.

## THE AMERICAN BALANCE PISTON VALVE.

One of the most interesting and promising improvements in piston valves has just been developed by the American Balance Valve Company, and is about to be tried on the Chicago & Northwestern Railway. The object is to combine the desirable features of the plug valve with facilities for automatic adjustment to the bore of the valve chamber, to obtain ample bearing surface of the packing rings by use of wide rings with absolute protection against excessive friction caused by steam pressure against the inside of the rings, and to do this with simple and durable devices. We have not in a long time seen such a neat mechanical design in connection with valves.

The improvement was developed by Mr. J. T. Wilson of the American Balance Valve Company. In Fig. 1 a form of packing is shown from which the idea was developed. In it the parts are lettered for reference. Fig. 2 is the application for the Chicago & Northwestern Railway. (A valve of this form attracted a great deal of attention at the Master Mechanics' Association convention in Saratoga last month.) Fig. 3 is an arrangement of the same elements for the Brooks Locomotive Works, and Fig. 4 is another form of Fig. 1, to meet the views of those who favor narrow rings. The idea in all of these is that of the beveled ring, which has been used for a number of years in the disc balance of this company, but employed in this case to produce wedging action on the packing rings and to secure steam-tight joints to keep the steam from getting under the packing rings.

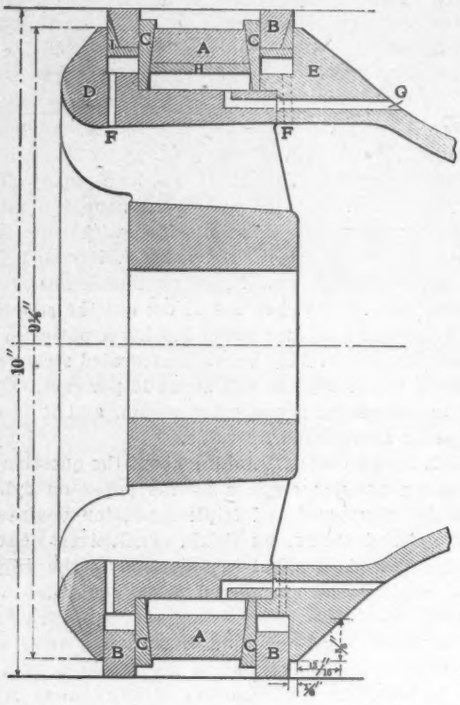



Fig. 1

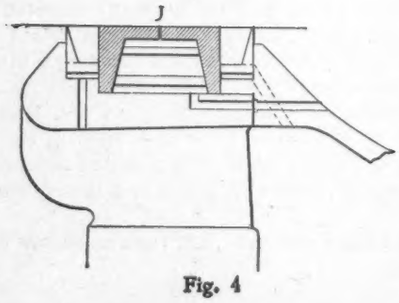



Fig. 4

In Fig. 1, A is a wedge ring under which boiler steam is admitted through the ports, G. This ring has ground joints with the solid rings, C, which may be made with or without flanges. The snap rings, B, may be made of any form or size, and these are wedged tight against the valve spool, E, and the follower, D, by the steam pressure inside of the ring, A. The spaces under the snap rings, B, are vented to the exhaust so that pressure can not accumulate under them. The rings are put under tension and turned on their outside diameter, so as to be perfectly cylindrical and true with the valve casings when placed in position, They are elastic and tend at all times to expand to fit the casing. When the throttle is closed the parts are free to adjust themselves to fit the casing, and when steam is admitted to the chest and to the center of the valve the wedge rings act at once to lock the packing rings in position, which produces essentially a plug valve as long as the pressure is on. The principle of Fig. 1 is used in the other forms illustrated. In the two designs for trial the valves are arranged for internal admission, but the parts may be reversed for outside admission.

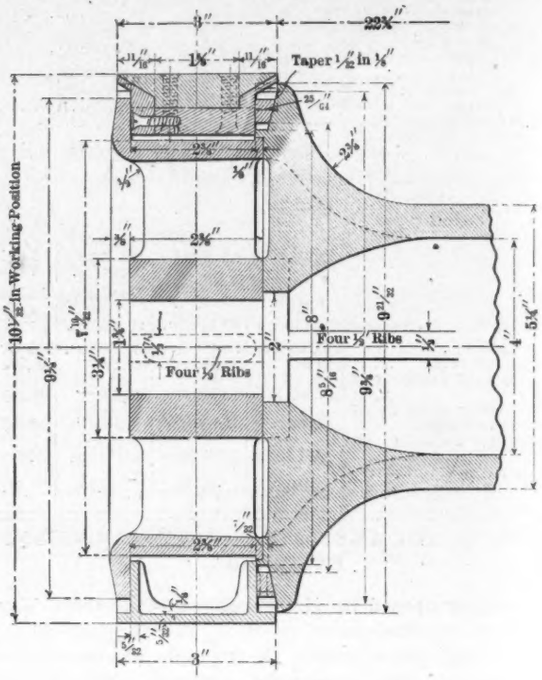



Fig. 2

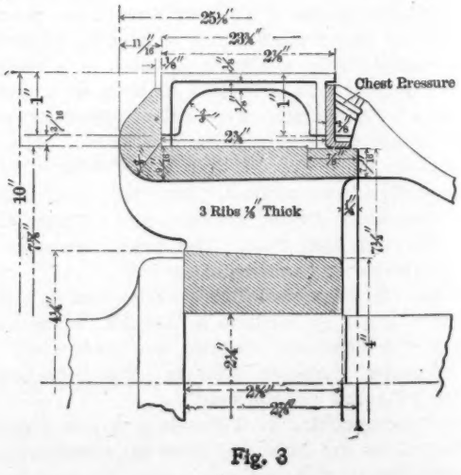



Fig. 3

These valves have continuous steam and exhaust lines because the rings are tapered at the joints and the joint plates

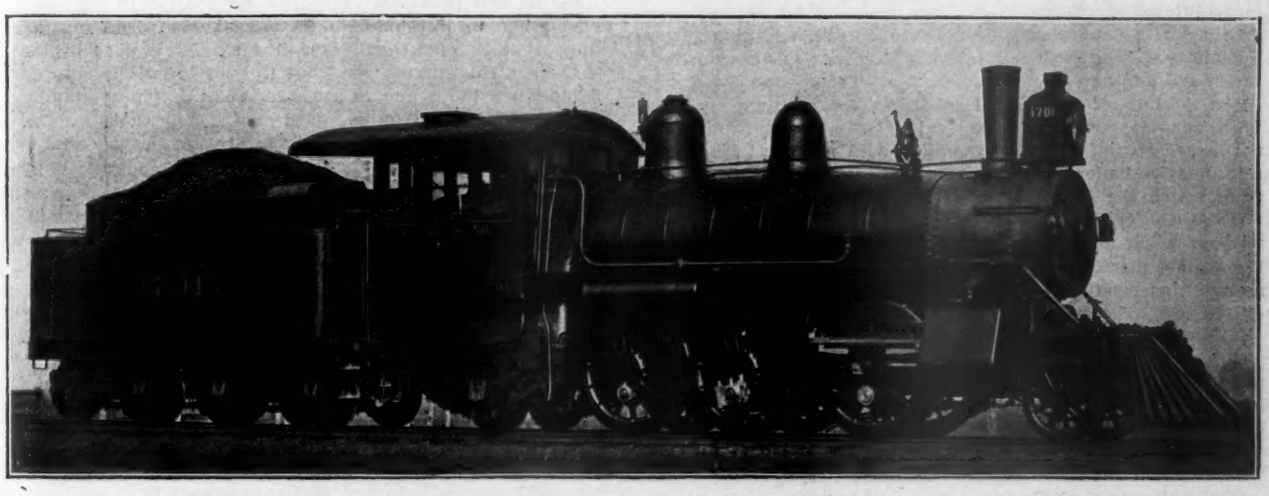
are tapered to fit the tapers of the rings at the joints. The steam-tight joints are made by the taper ring, which is easily ground to fit the face of the packing ring and the seat on the end of the valve spool. The arrangement is very simple, and the taper ring, being inside the flange of the packing ring, is protected, and it can not fall out even if it should break, which is not likely to happen.

It will be seen at a glance that the packing rings offer a sharp cutting-off edge which will not tend to disturb the direct current of the steam, which has occurred with some valves in which the controlling edge was back some distance from the end of the valve. There is every reason to expect this improvement to overcome the difficulties which have been found in several applications of wide packing rings, and we consider this a very promising and important improvement.

## PRAIRIE TYPE, WIDE FIREBOX LOCOMOTIVE.

Chicago, Burlington & Quincy Railroad.

Through the courtesy of Mr. F. A. Delano, Superintendent of Motive Power of the Chicago, Burlington & Quincy Railroad, a photograph of the new "Prairie Type" locomotive recently built by that road has been received. This engraving supplements the description of the engine printed in the April number of this journal, page 103.



Prairie Type, Wide Firebox Locomotive, C. B. & Q. Railroad.

Satisfactory service is reported for these engines and we are informed that the expectations of the designers are realized. In a short time we expect to be able to give definite information as to their performance.

The American Railway Asssociation Committee on Safety Appliances reported that on January 1, 1900, out of 1,283,679 freight cars in service, 1,191,189 (92.8 per cent.) were fitted with automatic couplers and 318,180 (63.7 per cent.) were fitted with air brakes. Also, that out of 34,319 engines reported, 33,435 (97.4 per cent.) were equipped with power brakes. New cars to the number of 102,485, under construction January 1, 1900, were all to be fitted with automatic couplers and air brakes.

## CASE-HARDENING MATERIAL.

A chemical mixture for hardening in furnace heat has been introduced by some of the largest ball and roller-bearing tool and machinery manufacturers, and is said to be preferable to any other material now in use. It is claimed that "Carburizer," manufactured by the American Carburizing Company, 160 Pearl street, New York, will harden steel to a greater depth of fileproof surface, with tough interior, than granulated bone, and in about half the time required by that material. Articles hardened with Carburizer will turn out smooth. Carburizer is about 30 per cent. cheaper than bone, because of its lighter weight.

## THE CLEVELAND LOCOMOTIVE.

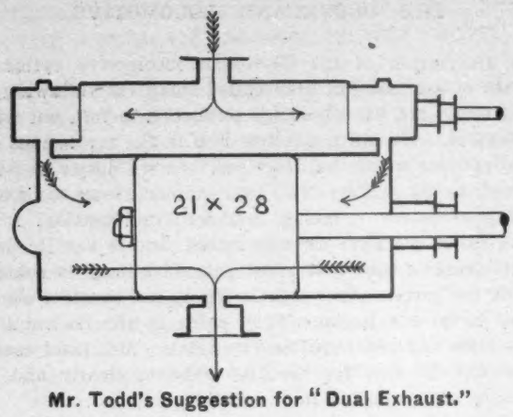
The description of the Cleveland locomotive cylinder on page 146 of our issue of May called forth the following communications. Mr. Cleveland's is published in full, but without endorsement. We can not follow him in the mysterious interchange of heat which he describes, but we desire to be perfectly fair to his engine. The dual exhaust seems to be an admirable device for reducing cylinder condensation, for the reasons which we have already stated, and it has the important attribute of simplicity, but this advantage is somewhat offset by the increase in weight. We do not consider the tests referred to as conclusive. They point to the desirability of further tests and continued service trials. Mr. Todd seems to have stated the case for the dual exhaust clearly and there appears to be something in it.—Editor.

To the Editor:

I have read with much interest your article, on pages 146 and 147 ante, describing the Cleveland dual-exhaust cylinders on the Intercolonial Railway of Canada; and would beg to point out that their economical action can be still further improved by making the elongated piston a light continuous shell, as shown on the accompanying diagram, instead of two separate narrow pistons, as you illustrate. The exhaust steam may be 150 degrees colder than that in the boiler, and it is therefore a thermodynamic mistake to allow it to have continuous access to the interior of the hot cylinder, in the space between the pistons.

Instead of the two central escape ports in the Cleveland cylinder, there should be only one, as on the diagram. The width of this should be one-tenth of the stroke, and the cylinder will then automatically exhaust at 90 per cent. of each stroke, quite irrespective of the working of the slide valve, even although it should be hooked-up right to the center. These central ports should be made with very ample area, leading into a large exhaust pipe carried from the bottom of the cylinder below the frame and then turning upward into the stack. This will leave very little of the cold residual steam to be expelled through the hot steam inlet port, and will also completely drain the cylinder without the use of special cocks. And if lap should be given to the exhaust side of the valve to lessen the time during which the cold exhaust has access to the hot interior of the cylinder, and also to prevent a too early release, it will not, if used in moderation, produce any choking from the small amount of residual imprisoned steam.

The Corliss cylinder, with its separate steam valve at the top and its separate exhaust valve at the bottom, was an advance on previous practice, as it prevented, to some extent, the cooling of the hot steam inlet by the cold waste steam, and also effectually drained the cylinder. And it is evident that the terminal-exhaust plan of getting rid of the greater part of the cold waste steam without allowing it to return to cool the




Mr. Todd's Suggestion for "Dual Exhaust."

initial end of the cylinder, where the hot boiler steam has to enter for the following stroke, is yet still a large step in advance of the benefits originated by Corliss; and this without any complication caused by the use of separate exhaust valves or additional mechanism.

In order to determine the precise advantages of this system I made a special experimental cylinder 6 ins. in diameter, and afterward another 10 ins. in diameter. These were fitted with cocks to shut off the central exhaust when required, and also with surface condenser and scales on which to weigh the condensed steam, and were supplied with steam at 160 lbs. by a locomotive boiler. With these many experiments were made, from which the following general results have been deduced:

(1) As the greater part of the cold waste steam is got rid of without being allowed to return and cool the hot inlet end of the stroke, therefore the inlet end of the cylinder is not cooled as much as usual; and therefore less steam than usual is required to fill the cylinder up to the point of cut-off.

(2) On account of this reduction of initial condensation, the steam pressure at the top side of the diagram starts several pounds higher than in an ordinary cylinder with the same boiler pressure; and on account, also, of the initial end of the cylinder being hotter than usual, the whole top side of the diagram is considerably higher than in ordinary cylinders working with the same pressure in the boiler.

(3) On account of the very large and free escape for the waste steam, which remains constant and quite unaffected by the slide valve motion, the bottom side of the diagram is always much lower than in any ordinary cylinder.

(4) Therefore, as less steam is used per stroke; as the top side of the diagram is higher, and as the bottom side of the diagram is lower, the dual-exhaust cylinder gives more diagram area or power, per pound of steam supplied from the boiler, than can be obtained from an ordinary cylinder, which releases all its cold waste steam from the initial end of the stroke.

Finally, the dual-exhaust cylinder is much more economical than usual; it is quite unapproachable for quickly getting rid of its waste steam; it has no more working parts than an ordinary engine; and hence, is an ideal cylinder (when properly proportioned and put to work) for fast running.

I beg to congratulate Messrs. Cleveland on their success so far, and hope to hear of still further advances in the future.

LEONARD J. TODD.

97 Queen Victoria Street, London, England.

To the Editor:

The article published in the May number of The American Engineer, on the Cleveland locomotive, is far from accurate in its attempted description of the distinguishing features of this invention, and equally erroneous in its alleged exposition of the principles which underlie its established economy in steam consumption. It is not desired in this paper to give any avoidable offence to the author, whose article seems to have been written in a friendly and unprejudiced spirit; but it would have been wise on his part to have first informed himself, by careful study and observation, since he has chosen to ignore the present views of both inventors.

The Todd locomotive, described in a previous issue, and cited as an experiment, analogous to those conducted on the Intercolonial Railway during the past three years, has really only a limited resemblance in design, and no bearing whatever on the main economic principles tested in the Cleveland locomotive. The single central exhaust port of the Todd locomotive has been the subject of many experiments, and for many years abandoned, from which we naturally infer that the results obtained gave little or no encouragement to the promoters. Aside from a possible reduction in back pressure and compression, it is difficult to discover a reason why these experiments should have terminated otherwise. The main piston and supplementary exhaust ports must necessarily open at about the same time, so that the advantages claimed for separate induction and exhaust ports are out of the question, and especially as the final exhaust, at a lower pressure and temperature, is discharged through the admission ports in the ordinary way. The rapid initial exhaust, due to the large port areas, should give a lower exhaust line and reduced compression, but why a saving in cylinder condensation should be claimed for the same reason is not so apparent. The greater capacity of the cylinder spaces, exposed for this reason for a longer time to a lower exhaust temperature, must inevitably give a contrary result, and the failure of the experiments should be attributed chiefly to this cause.

All the evil causes of cylinder condensation in the standard locomotive are retained, in an aggravated form, in this engine. It is claimed that better drainage is obtained by the use of the central exhaust port, but this advantage is only appreciable when the cylinders are cold, and the engine standing or moving slowly. In the standard engine it is the film of water clinging to the cylinder walls, or saturating the material available for compression and swept by the piston into the clearance spaces, that is the primary cause of condensation, which is also true of the Todd engine, but to a greater extent, for the reasons specified. The central exhaust port, being separated from the clearance spaces by the entire length of the stroke, affords no relief from this evil.

If water should pass the admission ports in sufficient quantity to separate from the steam, and gather on the bottom of the cylinder, or if condensation should become so bad as to effect the same result, a measure of relief would be afforded by the central exhaust port; but an engine in which such conditions continuously prevail would prove very economical as an addition to the scrap heap. If cylinder condensation is to be avoided, the walls and piston must be kept dry and the aqueous residue of out-worked steam removed, thus enabling the iron to accumulate the full initial temperature of the steam and at the same time explode the absurd fallacy that it can be made to accumulate or part with such a temperature in a fraction of a second. It is strange that engineers will cling to such a nonsensical theory as this, when the enormous heat-absorbing capacity of aqueous vapor is well known.

When saturated steam is instantaneously expanded from one chamber to another without doing work, as in the Cleveland cylinder, it becomes dry steam at a lower pressure, and thus also the film of water is re-evaporated from the walls and piston at every exhaust and a dry hot cylinder obtained after a few revolutions. Although there are other advantages which may be justly claimed for this improvement, they are chiefly tributary to this one or follow as effects of this primary cause of the engine's economy and success.

In future designs it is intended to further expand the exhaust by also discharging it through a direct channel into the central chamber of the opposite cylinder, whose pistons at the point of release are about at half stroke. This plan has been partially tested by changing the construction of the exhaust pipe of one of the engines now in use, but not to the fullest advantage, as the passages are not direct and entail unnecessary changes in the current of the steam before its final discharge through the nozzle. A very marked improvement in coal consumption, however, was at once obtained, which is conclusive proof, if such is required, of the soundness of this theory of exhaust expansion.

It is also intended to use annular induction ports instead of the common bridged ports, the bridges being unnecessary as the packing rings will then be wider than the ports. The ports through the valve sleeves will be narrower and of less aggregate area than would be admissible in the standard cylinder, no provision being here necessary for the discharge of the initial exhaust; but a greater area, owing to the absence of the bridges, will be obtained for the final exhaust, which the

higher piston speed at this part of the stroke renders desirable. The extent to which the aggregate port areas of the sleeves may be reduced without in any way diminishing the effective admission capacity will be recognized when it is considered that valve port openings of only ⅝ inch can be obtained in the largest locomotives at half-stroke cut-off. As the piston speed is always low with late cut-offs, the change in the port construction will then be immaterial, although the aggregate or effective port area will be less. The bridges reduce the effective port area, add to the initial fractional losses, and afford no protection from damage to the cylinder by small pieces of broken packing rings. Annular exhaust ports and wider piston packing rings are used in both the Cleveland engines, and give remarkable freedom from uneven wear and broken packing rings.

It is necessary to further explain the reference to "pockets for the accumulation of water." Water could not gather in the enlarged central portion of the cylinder, whether the ribs holding the section between the ports are placed as shown in the illustrations, or whether they are placed, as in the first Cleveland locomotive, in a single row in the center of the cylinder enlargement. The latter construction is preferable, as the exhaust port area is not reduced by the ribs. The main consideration in designing this portion of the cylinder is to provide ample area for the instantaneous expansion of the primary exhaust. The initial discharge is more rapid than desirable, and will draught the fires more efficiently when prolonged by expansion into the larger spaces of both exhaust chambers. These spaces will then be almost continuously subjected to the drying action of the exhaust expansion, so that the possibility of "water accumulations" will become still more remote.

During the admission periods a number of heat units are consumed in proportion to the work performed, or the loss by condensation sustained, but as the boiler is a continual source of supply until the port is closed the pressure is maintained so far as the port area and piston speed will allow. The effective pressure during this period has one source of maintenance, which is the entire volume of heat units stored in the steam and water in the boiler, pipes and engine. When the admission lasts throughout the stroke, a small proportion of these heat units is consumed in actual work, and a larger volume merely occupy the clearance and cylinder spaces, to be finally swept out and lost in the exhaust. As excessive clearance adds unnecessarily to this volume of wasted heat, it would be especially wise in an engine working under such conditions to avoid it to the utmost extent possible. After the steam supply is cut off from the boiler and expansion begins, the effective pressure is then entirely dependent on the volume admitted, and whether it is contained in the clearance or cylinder spaces, it is all equally valuable in maintaining the expansion line. But the larger the volume admitted, the less the range of expansion, and in this sense only, aside from the question of condensation, can the contents of the clearance spaces be considered loss, which is also true of the entire volume admitted. When steam is worked without expansion, the only difference between the losses sustained by the number of heat units discharged from the cylinder spaces and those discharged from the clearance spaces, is that the former loss cannot be avoided while the latter may be reduced by proper designing. When the steam is worked expansively the heat units stored in both the clearance and cylinder spaces are not used until expansion begins, or, to be more accurate, those that are used are replaced from the boiler; but if the range of expansion be sufficient to equalize the terminal and back pressures, condensation losses only should be charged to clearance. Hence the statement that "the greater the expansion the greater is the loss by clearance" is the exact reverse of the truth.

A greater range of expansion is obtainable in the Cleveland cylinder owing to the absence of condensation and consequent higher effective pressure. It is seldom found necessary to work the lever below the second notch of the quadrant, even on the heaviest grades. The clearances are small and filled by compression to approximate boiler pressure with dry, elastic steam, instead of the inert mixture of water and vapor to which the standard cylinder is accustomed. Initial condensation is thus reduced, possibly, to that resulting from actual initial work. The ideal engine, which has been the dream of inventors for generations, is more nearly approached than ever before by this fleet-footed flyer of the modern steel race track.

Moncton, N. B., Canada. W. F. CLEVELAND.

## WESTINGHOUSE GAS ENGINES IN BOSTON.

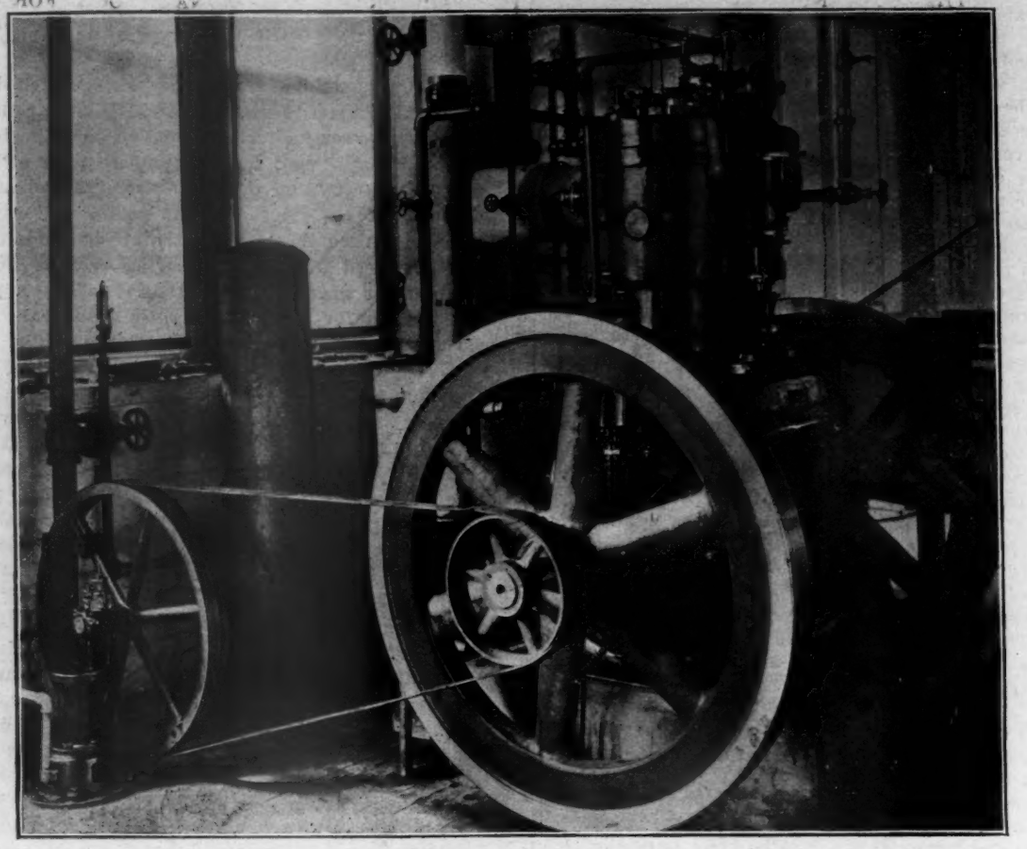
By Burcham Harding.

Some interesting information was secured by the writer when called upon to inspect several Westinghouse gas engines providing power for factories and shops in Boston. The present high cost of coal, and the reduced price of gas in Boston attract the attention of power users to the advantages and economy of gas compared with steam engines. It has long been recognized theoretically that if gas, obtained from coal, could be used directly for driving engines, such a method would be far more economical than if gas was applied to generating steam for operating engines. But only during recent years have gas engines been designed which compete successfully with steam engines in regulation and steadiness of operation.

One of the Westinghouse gas engines visited by the writer, is at the works of the Trimont Manufacturing Company, Roxbury, a large factory devoted principally to producing wrenches, pipe-cutters of a high class and special tools. Power for the works is supplied by a Westinghouse two-cylinder gas engine of 65 horse-power, for which either gas or gasoline may be used as fuel. In the main building a large number of special tools are belted to lines of shafting extending from end to end. In the forging department power is used for operating a number of hammers driven by belts from shafting. The forging hammers, when several are in use simultaneously, place very heavy intermittent strains upon the engine, but the regulation under the varying load is extremely good, changes being noticed only by the greater or less amount of air drawn into the valve for admixture with the charge of gas. With the Westinghouse gas engine the frequency of the impulses is the same for all loads, and the relative proportions of gas and air remain constant, but the amount of the charge admitted to the cylinders, and the consequent strength of the impulse, is graduated exactly for the power required. This system gives a nicety of regulation equaled only by the best types of automatic steam engines. The engine at this factory is run night and day, being stopped only for 20 minutes each day when cleaned and oiled. This steady work has been continued since it was installed in August last. Water for cooling the cylinder jackets is taken from a local well or from the city mains. Part of the discharged water, which has a temperature of 160 degrees, is converted into steam by contact with the exhaust gas, and circulated through the steam radiators for heating the buildings; the remainder is utilized as feed water for the boiler. The fuel gas is supplied by the New England Gas and Coke Company at 60 cents per thousand cu. ft., and contains 650 British thermal units per cu. ft. The average consumption is 17 ft. per horse-power hour, or about 1,100 cu. ft. an hour.

Before the installation of the Westinghouse gas engine, power was supplied by a 55-h.p. steam engine, in conjunction with a 20-h.p. gasoline engine of another make installed in the machine shop. Under the new system not only is there a very great economy in the cost of fuel, but the cost of attendance is reduced, as the engine requires very little attention from the engineer who operates a turret lathe in the engine room.

Another interesting plant is that of H. K. Porter, at Everett, Mass. A 25-h.p. Westinghouse gas engine, which is shown in the illustration accompanying this article, supplies power and heat for this factory upon terms so economical as to be phenomenal. The factory produces bolt clippers in various sizes, from 18 ins. in length, used to clip 5/16-in. bolts, to those 36 ins. in length for clipping ⅝-in. bolts by hand. The 8 by 10 in. gas engine, with two cylinders using gas as fuel, is situated upon the ground floor and is belted to shafting on the same floor and also to the floor above. The gas is secured direct from the gas works which are near by, the bill for fuel being extremely low, not exceeding 50 cents a day. Water for cooling the cylinder jackets is taken from the city mains; part



Westinghouse Gas Engine—Works of H. K. Porter, Everett, Mass.

of the discharge water flowing through a heater 8 ft. high and 15 ins. in diameter, which supplies hot water for heating the building and for pickling the castings and steel forgings. The waste gases from the engine enter the heater at the top, and striking a baffle plate are distributed through the internal pipes and raise the water to a temperature of 180 degrees. The remainder of the discharge water enters the top of a tank 9 ft. high, and is re-drawn from the bottom of the tank for cooling purposes, there being a difference in temperature of 100 degrees between inlet and outlet. The air compressor which supplies the pressure tank for starting the engine is driven by a belt, and the compressed air is also used for sounding the factory whistle and is piped to special tools for removing waste material. At this factory gas is used for power, heat, light and annealing.

The New England Electric Vehicle Transportation Company employ a 25-h.p. Westinghouse gas engine for charging automobile batteries and supplying light, at their establishment near the reservoir at Brookline. The engine is in the basement of the building connected by belt to a 15-kw. Westinghouse compound-wound direct-current generator, supplying current from 110 to 150 volts by means of a regulator which varies the voltage. About thirty 16-c. p. lights are connected with the circuits, the remainder of the current being used for charging the batteries of automobiles. This latter demand is dependent upon the state of the weather so that the engine is sometimes continuously in operation, and at other times stands idle. Gas engines are specially fitted for this intermittent work, as they can be started and stopped with so little trouble, and when not in use no expense is incurred. The air compressor, in addition to being used for starting the engine, is used to pump up the automobile tires, and compressed air is used for cleaning the motors. The gas for fuel costs 13 cents an hour, being charged at 60 cents per thousand cu. ft. The exhaust from the engine is carried by a pipe above the eaves of the roof; a muffler at the top deadening all sound.

## LUMEN BEARING METAL.

Bearing metals, being one of the subjects before the Master Mechanics' Association, occupied a large share of attention at the recent conventions and interest was shown in the new Lumen bronze manufactured by the Bierbaum & Merrick Metal Company, of Buffalo. This company, besides their regular exhibit, had a pair of main rod bearings which were loaned for exhibition after making 150,000 miles, and after the conventions they were returned to the road from which they came to go into service again. They were in admirable condition, which was a strong endorsement of the claims made for the metal. This bronze was invented by Prof. R. C. Carpenter, of Cornell University, and it was not placed on the market until it had shown successful service for a year and a half in main rod-bearings as a substitute for phosphor bronze. The metal is an alloy which is cast and machined like ordinary brasses and bronzes. Its specific gravity is 6.9, its weight being less than that of brass. Other characteristics determined at Cornell University are as follows: Tensile strength, about 30,000 lbs.; compressive strength, 75,000 lbs.; torsional strength, 35,000 lbs. It is very smooth when cast, and has a shrinkage of 7/64 in. per foot when cast in sand molds. In the solid state its coefficient of expansion is 0.000015 in. per degree F. Bulk for bulk, its weight is from 15 to 25 per cent. less than bronze, the weight of bronze depending, of course, on the composition. There is a distinct advantage in cost because of this lightness. Its compressive strength is sufficient to give good bearing qualities under heavy loads, and it does not appear to cut the journal. In remelting it is stated that there is no deterioration such as occurs in remelting brass and bronze, and lumen metal has the peculiar property of increasing in strength, both tensile and compressive, when heated to 350 deg. F. The metal is a very promising one and worthy of the careful investigation of our readers. We have taken pains to inquire about its service, and have strong indorsements, but have not received any adverse reports or criticisms. The Bierbaum & Merrick Metal Company is represented in Chicago by Mr. G. S. Wood, 95 Washington Street.

## THE MORTENSON LOCK NUT.

### For Bolts in Wood and Iron.

A nut lock for car work, rail joints, switches, frogs, crossings and in fact all iron structures where nut locks are required, which is less expensive and more reliable than the ordinary double or jamb nut, has for a long time been needed and many devices have been brought forward to meet the requirements. A simple and apparently effective solution has been reached in the Mortenson nut lock, which is illustrated by the accompanying engraving showing its application to track bolts and woodwork. In this device the nut has slits cut at the corners in a plane parallel to and near its bearing face. The washer or angle bar has a depression cut, stamped or rolled into it and the nut, after being screwed home, is secured in place by opening one of these slits and forcing one of the corner lips of the nut into the groove. If stamped, the depression may be made when the holes are punched. The nuts are made of soft steel and the lips are easily bent down without danger of breaking them off. By advancing the nut a short distance on the bolt, the lip is returned to its original position and the nut may be removed in good order for future use. The additional cost of manufacture is merely that of making the cuts, an inexpensive item, when done when the nuts are still hot, in special machines. In car work the grooves in the washers may be cut, stamped or cast, as required, and on fish plates it may be made by the rolls or stamped. The engraving also shows the application of the device to woodwork trestles or bridge work where cast washers are used. In the lower left hand corner the method of turning down one of the lips with a wedge-shaped chisel is shown.

We are informed that this nut lock has been used for 5 years

The Mortenson Lock N t.

by the Southern Pacific in track joints with satisfactory results. This is believed to be a thoroughly reliable nut lock. It has the advantage of preserving both bolt and nut without injury and may be used many times. A glance at this engraving will convince anyone that it will not loosen in service. It appears to be as secure as a split key. If, as in the case of new work, rust or scale for iron, and shrinkage for woodwork, prevent the nut from coming at once to a permanent bearing, with this lock the nut may be tightened up like an ordinary nut and when brought to a bearing again the lock nut is fastened as before. The address of the Mortenson Lock Nut Company is 803 East 170th street, New York.

## BULLOCK "TEASER" PATENTS SUSTAINED.

A decree has been entered in the cases of the Bullock Electric Manufacturing Company vs. Baltimore Evening News and Bullock Electric Manufacturing Company vs. Geo. Knapp & Company, publishers of the St. Louis Republic, using the Crocker-Wheeler System, sustaining the validity of the "Teaser" patents, finding an infringement by the defendants and ordering an injunction. The "Teaser" patents cover a system for operating large newspaper presses and other machinery by electricity. The invention is the result of several years of experimenting involving great expense, and this decision gives to the Bullock Company the exclusive right to the manufacture of this apparatus. The "Teaser" System is now installed upon many of the larger daily newspaper presses in this country and England and has proven to be a very successful and economical method for this work.

## AIR BRAKE AND SIGNAL COCK FOR CONTROLLING FROM REAR OF TRAINS WHEN BACKING.

Present methods of handling trains between passenger yards and terminal stations require reducing the number of train movements to the minimum and trains are almost universally backed into the terminal station from the yard and backed out to the yard after the run, by the road engine used on the run. This renders it necessary to provide satisfactory methods for controlling the train brakes from the back end and placing in the hands of the brakeman a satisfactory warning signal. The accompanying engraving illustrates a device manufactured by Sherburne & Co., 53 Oliver St., Boston, which is designed to fulfill these requirements. It is a combined plug-cock and alarm whistle (A) attached by a short length of hose or pipe to the "train pipe" of the rear car. The whistle is blown by pressing the button (B) shown in the cut, which allows air to pass through the hollow handle of the cock to the whistle, which is shown on the end of the handle, blowing the whistle and giving the necessary alarm. The manufacturers state that the air used for this purpose, on account of the design of the whistle valve, does not affect the brake system. By moving the handle of the cock in either direction air is exhausted from the train pipe, through the opening C, the brake set, and consequent positive control of the train given. The device is also valuable in switching of freight trains, especially during the night or in thick weather, as the train by its use is under complete control from both ends.


Air Brake and Signal Cock.

## THE "K. A. K." ELECTRIC THIRD-RAIL SYSTEM.

We illustrate this system on page 157 of our issue for May, 1900. The third-rail principle of electric railway construction is the latest development of methods and it presents peculiar advantages for service on elevated and suburban roads, and also for converting steam into electric roads. The third rail is secured to the ends of the ties close to one of the traffic rails. The conducting rail of this system is of iron or steel, made with an ample section, and into the corner of this conductor the trolley fits and bears. The conductor is protected on top and sides in such a way as to avoid difficulties with snow and ice and to render it impossible for passengers or track men to come into contact with the "third rail." It is equally well protected from grease, which would interfere with its operation, by the manner of making the connection on the inner and under surfaces. There is no difficulty in providing for road on track crossings even when they involve a number of tracks. Where the system crosses country roads the conducting rail is cut out for the width of the road and the space is bridged by wires enclosed in pipes. The current is continuous the whole length of the road, and by using two trolleys, one on each end of the car, the crossings are spanned and the cars operated without difficulty. This system is protected by patents and the proprietors are prepared to furnish specifications and estimates and are ready to co-operate with those who are interested in electric transportation. Information may be obtained from Mr. O. S. Kelly, Springfield, Ohio.

(Established 1832)

AMERICAN ENGINEER AND RAILROAD JOURNAL.

PUBLISHED MONTHLY
BY
R. M. VAN ARSDALE,
J. S. BONSALL, Business Manager.
MORSE BUILDING.....NEW YORK

G. M. BASFORD, Editor.
E. E. SILK, Associate Editor.

JULY, 1900.

**Subscription.**—$2.00 *a year for the United States and Canada; $2.50 a year to Foreign Countries embraced in the Universal Postal Union.*
*Remit by Express Money Order, Draft or Post-Office Order.*
*Subscriptions for this paper will be received and copies kept for sale by the Post Office News Co., 217 Dearborn St., Chicago, Ill.*
*Damrell & Upham, 283 Washington St., Boston, Mass.*
*Philip Roeder, 307 North Fourth St., St. Louis, Mo.*

## EDITORIAL ANNOUNCEMENTS.

**Advertisements.**—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

**Special Notice.**—*As the* AMERICAN ENGINEER AND RAILROAD JOURNAL *is printed and ready for mailing on the last day of the month, correspondence, advertisements, etc., intended for insertion must be received not later than the 20th day of each month.*

**Contributions.**—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

**To Subscribers.**—*The* AMERICAN ENGINEER AND RAILROAD JOURNAL *is mailed regularly to every subscriber each month. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery, and in case the paper is not then obtained this office should be notified, so that the missing paper may be supplied.* **When a subscriber changes his address** *he ought to notify this office at once, so that the paper may be sent to the proper destination.*

*The paper may be obtained and subscriptions for it sent to the following agencies:* **Chicago,** *Post Office News Co., 217 Dearborn Street.* **London, Eng.,** *Sampson Low, Marston & Co., Limited St. Dunstan's House, Fetter Lane, E. C.*

## THE M. C. B. AND M. M. CONVENTIONS.

The conventions this year were unusually well attended, and the number of exhibits was larger than ever before. The reports and discussions were disappointing in some respects, but, nevertheless, a large number of very important points were brought out and a number of tendencies toward improvement were plainly indicated. There seemed to be no serious objection to the plan of holding both conventions in a single week, although it cannot be said that the consolidation of the associations is brought any nearer by the concentration of the time of the conventions this year. The comfort and convenience of Saratoga as a meeting-place again impressed everyone, until a great many expressed themselves as hopeful of settling upon Saratoga as a permanent place of meeting. It is understood that citizens of the village have offered to provide permanent quarters for meetings and exhibits, and such a plan would seem to be very advantageous from every point of view. It is particularly attractive to the exhibitors who would profit by the possibility of leaving certain heavy exhibits from year to year, and the convenience of a building especially adapted to exhibition purposes would be appreciated by all. The strongest argument in favor of such a scheme is the possibility of having a hall in which discussions may be heard. Nothing kills the enthusiasm of a public gathering as does the inability to hear the speakers, and with organizations of this character too much attention cannot be given to securing a good hall. This year was not an exception in this respect.

### Master Car Builders' Convention.

The fact that the power of locomotives and the weights and capacities of cars have far outgrown present draft gear stood out as the most important technical question in this convention. The tractive power of locomotives, based on 25 per cent. of the adhesive weight, has now reached over 56,000 lbs., and the hauling capacity back of the tender in the recent design of the consolidation type for the Pittsburg, Bessemer & Lake Erie is said to be 7,800 tons, and yet the draft gear capacity is usually less than 19,000 lbs. Something better is needed, and the Association will do well to include in its further work on this problem an examination of friction draft gear, which will absorb 140,000 lbs. Another feature of this question which did not appear prominently in the discussion is the effect of increased spring capacity upon the recoil of draft gear in the trains. It does not seem sufficient to provide more springs unless their reflex action is provided for. The work of this committee will be continued next year and there appears to be plenty to be done.

A great deal was expected from the discussion of center plates and side bearings, and while we should place this second in importance in the technical subjects, no finished result was attained, but next year we may expect some opinions on the question of the design of bolsters, center plates and side bearings, giving information as to the desirability of constructing bolsters to carry their loads free of the side bearings and of the possibility of constructing side bearings making use of rollers in such a way as to carry a proportion of the load continuously upon them. There seems to be a desire to use roller side bearings, and there is reason to believe that they will be able to carry loads continually without flattening the rollers. The advantage sought is the lightening of the bolsters, which would not need to be so stiff and heavy under this arrangement. A question which should be definitely settled is the allowable pressure on center plates. One of the committees recommended 400 lbs. per square inch, and the other recommended double that amount. They cannot both be right. In this side-bearing question the effect of the high center of gravity of large-capacity steel coal cars has not been properly considered. There is reason to fear destructive stresses if such cars are allowed to rock with separated side bearings. This was not mentioned in the discussion, but it appears to add an argument to those in favor of roller bearings continually in contact.

A revision of the specifications regarding the chemical composition of freight axles has been decided upon as the result of an apparently innocent suggestion of a desirable reduction in the proportion of carbon in freight axles because of the rough usage which they receive in interchange business in the matter of cooling the journals in the case of hot boxes. It became apparent at once that such a change required most careful treatment. It involves the most complete understanding of steel, and there is no doubt of the fact that the carbon should vary with the size of the journal. It would be worth while to bring to bear upon this question the knowledge and experience of specialists in steel, and expert opinions by those who are bringing the microscope into their researches will be worth having.

The Interstate Commerce Commission is worrying not a little over the condition of uncoupling attachments to automatic couplers, and a communication from that body to the Association to the effect that many M. C. B. couplers are not automatic because of the poor condition of the unlocking devices ought not to fail unheeded. If these devices are not maintained an M. C.

B. coupler may be made more dangerous than the old form. The force of this criticism was apparently appreciated and one result of the discussion may be to include in the interchange rules the standards of the Association in such a way as to compel the use of proper devices in safe condition in interchange business.

In his opening address as President of the Association, Mr. Schroyer proposed an important change in the basis of representation in the Association. At present no account is taken of the value of cars, but the possession of 1,000 eight-wheel cars gives one vote. The recent advent of the large capacity car makes the old basis somewhat unfair, and it was suggested that the vote should be counted with reference to tonnage. The question is too important for hasty action, but it is likely to be a feature of a future convention.

The Brakeshoe Committee had no tests to report this year, although a number of private tests had been made at Purdue University. An important step which will greatly simplify future work in brakeshoes was the decision to ask the committee to formulate specifications for the frictional qualities of shoes, and other qualities, if possible, with which new brakeshoes may be required to meet before being considered as worthy of trial by railroads. A surprising tendency to use hard shoes with wearing qualities predominating at the expense of frictional effect was developed at this meeting. This is a dangerous tendency in view of the increasing speeds. One of the speakers was surprised to find freight train speeds about sixty-five miles an hour on his own road recently and believed that freight equipment should be constructed with a view of resisting the stresses of such service. In view of this such a dangerous tendency in regard to brakeshoes should be checked.

Among the items of business of this convention one of the most important was the decision to authorize the preparation of an elaborate index of the proceedings from the beginning.

### Master Mechanics' Convention.

The whole of this convention was affected in an unpleasant way by the first matter of business brought up, that of the election of honorary members. It seems strange that in an association of this character an hour should be consumed over such a matter and that it should be necessary to expunge the discussion from the record. This points to the desirability of improving the constitution to make a recurrence impossible. Steps have been taken in this direction to be carried out next year.

Some excellent reports were presented this year, among which those of most importance were on electric transmission of power, compound locomotives, piston valves and the ton-mile basis of motive-power statistics. A novelty in the convention was the report of a committee on "What Can the Association Do to Increase Its Usefulness?" This was a species of self examination, and many other technical organizations will do well to follow the example. It would be a good idea to appoint a committee of this kind about once in five years to review the work done and propose improvements of various kinds. We think the most important thought in this report was that of a concentration of effort in the direction of giving the proceedings a high place in technical literature, this being the underlying idea of the committee in all of their recommendations.

Important work was done by the committee appointed to examine present practice with regard to the extent to which the recommendations of the Association have been carried out during the thirty-two years of its existence. From this retrospective view it appears that a very large amount of the work of the Association is not represented in locomotive practice today. Perhaps this was not to be expected, but nevertheless the report is suggestive. As this Association has nothing equivalent to the interchange of cars to compel the use of its standards its work in this direction will probably always be somewhat behind that of the Master Car Builders' Association. It is believed, however, that the method of circularizing the Association failed in this case, as in many others, to bring out the facts as to the practices of the members, and that the recommendations have probably been adopted on a number of roads not represented in the replies. The work of this committee also is needed about once in five years.

It is difficult to say too much in praise of the report by the committee on electric distribution of power. It was a most satisfactory presentation of the reasons for using electrical distribution and contained practical suggestions based upon experience to assist in the selection of the elements to suit various shop conditions. The committee also brought in practice in the form of descriptions of electrical distribution in prominent manufacturing and railroad shops. It is to be hoped that every railroad officer having to do with motive-power matters will give this paper his careful consideration.

The compound locomotive has evidently advanced in the estimation of the members of the Association and it can no longer be said to be in the experimental stage, except in the sense that the locomotive will always be undergoing improvement. There seemed to be a stronger tendency than ever before to regard the compound as advantageous in passenger as well as in freight service, although the greater economy is to be expected in freight service. It appears from the records of the largest builders of locomotives, The Baldwin Locomotive Works, that more than 50 per cent. of the engines built by them last year were compound.

In the discussion of the ton-mile basis of motive-power statistics no criticisms of the principles of ton-mileage figures were offered, attention being given chiefly to matters of detail, such as the question of whether the weight of the engine should be included. The most important facts introduced were the lack of uniformity of units on different roads and the desirability of securing records early in each month. Figures should be so simplified as to permit of getting the returns promptly, especially when the work of men is to be compared, because statistics, which come late, lose their value in the effect on the men, no matter how elaborate and accurate they may be.

There seems no longer to be any question of the correctness of principle of the piston valve. Cast iron wheels were frankly stated by one member to be safer than some steel-tired wheels. There was an almost unanimous expression of opinion in favor of using flanges on all the driving wheels of locomotives. A tendency to consider a lengthening of boiler tubes as advantageous was shown in one of the topical discussions. It was evident that an increase of mileage of locomotives is sought for, whether by pooling or using a number of crews on each engine, but it was made clear that individual responsibility for the condition of the engines is important and that some of the money saved by pooling might profitably be reinvested in the form of better care of the engines.

These comments and the reports to be found elsewhere in this issue present the chief thought brought out in the meetings.

---

The Westinghouse Air Brake Company has decided to discontinue the use of the oil hole in the standard brake cylinders, because of the trouble arising from carelessness in applying oil through them and the use of the opening as a makeshift substitution for proper cleaning and lubrication.

---

T. B. Blackstone, for 25 years President of the Chicago & Alton, died at his home in Chicago on May 26. Mr. Blackstone was born at Branford, Conn., March 28, 1829. He began railroad service in 1847 as rodman in the work of surveying the New York & New Haven Railroad. He worked as Division Engineer on the Stockbridge & Pittsfield, on the Vermont Valley and the Illinois Central until 1856, when he was made Chief Engineer of the Joliet & Chicago, in which position he continued until 1861, when he was elected President of the road. When the Chicago & Alton was formed in 1864 he was elected President, from which office he retired April 28, 1899.

## PERSONALS.

Mr. J. N. McCarthy has been appointed Purchasing Agent and Chief Clerk to the President of the Florence & Cripple Creek, with office at Denver, Colo.

Mr. John Foster, Superintendent of Motive Power of the Colorado & Southern, has tendered his resignation, to take effect June 15, and it is stated that he will be succeeded by Mr. A. L. Humphrey, Superintendent of Motive Power of the Colorado Midland.

Mr. W. F. Brunner has been appointed Chief Clerk of the Western Passenger Association, with headquarters at Chicago. Mr. Brunner has been City Ticket and Assistant General Passenger Agent of the Vandalia-Pennsylvania at St. Louis for many years.

Mr. Alexander Kearney, Assistant Engineer in the office of General Superintendent of Motive Power F. D. Casanave, at Altoona, has been appointed Master Mechanic of the West Philadelphia shops of the Pennsylvania Railroad, to succeed Mr. R. N. Durborow, resigned to go to the Philadelphia, Wilmington & Baltimore as Superintendent of Motive Power.

Mr. G. S. Wood has been appointed Western Representative of the E. J. Ward Company, Car Furnishings, with offices at Hobbs Building, 95-97 Washington St., Chicago. He has also been appointed representative of the Bierbaum & Merrick Metal Co., manufacturers of Lumen Bronze. Both of these firms are to be congratulated on securing his services.

Mr. L. H. Flanders, who has been an Instructor in the mechanical laboratory of Armour Institute of Technology, Chicago, has accepted a position in the Gas Engine Testing Department of the Westinghouse Machine Company, Pittsburg. The vacant instructorship will be filled before the opening of the school in September.

## BOOKS AND PAMPHLETS.

Reinhardt's Technic of Mechanical Drafting, by Charles W. Reinhardt, Chief Draftsman Engineering News. New York: The Engineering News Publishing Co., 1900. Price, $1.

This book is written with the view of helping those draftsmen who are already familiar with mathematics and principles which have to do with the laying out of a mechanical drawing. It is the author's purpose, as stated in the preface, to present to the busy draftsman a thoroughly practical and commonsense guide to good mechanical drafting. The various requirements of a legible drawing such as are met with in practice are well presented, with the exception of the subject of lettering. He, however, refers to a book on free-hand lettering, also written by himself. The errors common to draftsmen, such as inconsistencies in a drawing and the lack of such information as will make them easily read, will be easily guarded against by knowledge of the author's suggestions, which are sure to prove a help to those who will follow them in efforts to produce neat, correct and legible drawings.

Mechanical Engineer's Pocketbook for 1900. Edited by William H. Fowler, Wh. Sc., M. I. Mech. E., M. Iron and Steel Inst. Published by The Scientific Publishing Co., Manchester, England. New York: D. Van Nostrand Co. Bound in leather; pocket size, 4 by 6 in. Price, $1.

This is a good and conveniently-bound book, which has the advantage of annual revision and low price. It contains a large amount of advertising matter (this explains the low price) but it is disposed of in such a way as not to annoy the reader. The impression given the reviewer is that of being up to date, especially in matters of high steam pressure, gas engines, electrical machinery, textile machinery and machine shop tools. The common practice of filling many pages with mathematics and chapters on mechanics has not been followed here, the space being given to tabular matter. We should say that engineers following almost any special practice will find this book very convenient to consult for information on the state of the art in general mechanical engineering practice. The book shows evidence of care in editing, and in the preparation of the matter. It is one which engineers will keep within easy reach of their desks.

Storage Batteries.—The Gould Storage Battery Company of Depew, N. Y., have issued a new catalogue on storage batteries and supplies. These batteries are the result of that which practical experience in central-station lighting and power plants and in all other storage battery lines has shown to be necessary to make the most efficient and durable battery. The catalogue gives complete instructions for setting up, operating and maintaining storage batteries. Information and data, together with this catalogue, will be furnished to parties considering the use of storage batteries for any purpose, by addressing the New York office, Astor Court Building, 25 West 33d Street.

Pneumatic Tools.—The Chicago Pneumatic Tool Company have just sent us a new catalogue which they have issued for distribution at the Paris Exposition. The description of each tool or machine is concise and is printed in English, French and German. The catalogue also illustrates tools for all branches of industry which are in use in a number of important shipyards, railroad shops and manufacturing plants. The engravings represent these tools in practical operation. The presswork represents a very high degree of perfection and brings out with remarkable clearness the most minute details in every instance, and as a whole this is a very attractive and beautifully illustrated catalogue.

The Harrison Dust Guard.—A small folder has been issued by the Harrison Dust Guard Company, Spitzer Building, Toledo, O., giving the number of guards ordered and furnished to the American Car and Foundry Company, Barney & Smith Car Company, Pullman Car Company, Pressed Steel Car Company, Illinois Car & Equipment Company, Richmond Locomotive Works, Brooks Locomotive Works and International Power Company, during the month of May, 1900, which was a total of 33,712. This number does not include the orders from the railroad companies.

In the Adirondack Mountains.—People who are familiar with the "Four Track Series" issued by the passenger department of the New York Central, as well as those who do not know what a great aid this series is to people seeking pleasure and recreation in the territory tributary to this road, will be glad to learn that Nos. 6 and 20 of the "Four Track Series," entitled "In the Adirondack Mountains," has just been issued. The former is a booklet of 72 pages containing many illustrations of such beautiful mountain scenery as to immediately set up a yearning for the woods and the smell of the camp-fire. Illustrations of the principal hotels are given, together with a brief description of the places and large maps; also a complete list of the hotels and boarding houses with their location and rates. Number 20 is a 48-page folder containing large maps of the region and valuable information which cannot be found in any other publications. The book or folder will be sent free, postpaid, to any address, on receipt of a postage stamp, by George H. Daniels, General Passenger Agent, Grand Central Station, New York.

The Hayden & Derby Mfg. Co., 85 Liberty St., New York, with factories located at Bridgeport, Conn., have just issued a new catalogue, standard size, 9 x 12, of 28 pages, illustrating the "Metropolitan 1898 Locomotive Injectors," for locomotive service. The catalogue is very complete, showing the various types which they manufacture, also plates showing the specifications as to sizes of pipe connections, and details as to repair parts. This catalogue also illustrates in detail the H-D locomotive strainer, the H-D combined stop and check valve, the H-D swing, intermediate and line check valves, main steam valves and main boiler check valves, all as applied to locomotives. Many of the other products for ejectors and injectors for stationary boilers and locomotives are illustrated in detail. In addition to the usual price list showing pipe connections, this new catalogue shows the detail tables of capacities with various temperatures of feed water, the range of capacity with various steam pressures and various temperatures of feed

water, which is especially interesting to railroads and railroad men now that the subject of heating the feed water is being so generally discussed and advocated. The Hayden & Derby Mfg. Co. will be pleased to mail this catalogue to anybody upon application.

A small folder has just been received from the Joseph Dixon Crucible Co., miners, importers and manufacturers of all forms of Graphite, showing engravings of the American Exchange National Bank Building and the Broadway-Chambers Office Building, both in the course of erection in New York City. The steel work of these buildings is protected with silica-graphite paint, manufactured by this company. The folder also gives paint specifications calling for the use of Dixon's silica-graphite paint for the protection of structural steel and tin roofs.

Machine Tools.— The Pond Machine Tool Company of Plainfield, N. J., have issued a unique and very handsome catalogue for distribution at the Paris Exposition. This little book of 95 pages is 5 by 9 in. in size and bound in heavy boards. The products of this company are confined to a line of machine tools, including engine lathes, planers, radial drills, boring and turning mills and railroad shop machinery for wheels and axles. These tools, which are of the most modern design, heavy and powerful, are the subjects of this book. Each class of machine is given a general description in English, French and German and illustrated by excellent engravings. The book is well printed, making it very attractive.

The Russell Snow Plow Co., 751 Tremont Building, Boston, have issued their catalogue for 1900, from which it appears that during the past two seasons the demand for their plows has been greater than the capacity of the works to supply. This being the time for considering such equipment for next winter, the early placing of orders is urged. Our readers are familiar with the features of these plows, but to be informed of the latest applications of the experience of these builders copies of the pamphlet should be obtained. The illustrations are excellent and the catalogue closes with a strong guarantee of the plows by the manufacturers, whose wide experience should be considered when ordering new equipment of this kind.

Oue of the handsomest souvenir catalogues distributed this year at the Master Mechanics' and Master Car Builders' Conventions was that of the Bullock Electric Manufacturing Company, Cincinnati, O. The pamphlet illustrates characteristic designs of their dynamos and motors, also several applications of the Bullock motors, specially designed for direct connection. This unique and interesting book is believed to be the work of Mr. F. G. Bolles, manager, Advance Department of the Bullock Electric Manufacturing Company.

The J. G. Brill Company have issued a pamphlet illustrating and describing their "No 27 Perfect Passenger Truck." This truck, which was designed for electric and steam railway service, was fully described in the March and July, 1898, issues of this paper. The Brill truck, which is well known to our readers, has shown the only important improvements in design for passenger trucks during a number of years. That the construction has attracted the attention of motive power officers was plainly evident at the April meeting of the New York Railroad Club, when the subject of Standard Trucks for Railroads was discussed. Copies of this attractive little pamphlet may be had by addressing the J. G. Brill Co., Philadelphia, Pa.

Hydraulic Pumps.—The Watson-Stillman Company, of New York, have issued a new catalogue, No. 56, which is one of a series of subdivided catalogues covering their machinery for a great variety of purposes. This book brings together in very convenient form an assortment of illustrated sheets of hydraulic pumps, among which are testing pumps, horizontal double-plunger hydraulic pumps, side cistern single and double-plunger hand pumps, 1, 2, 3, 4 and 6 plunger belt pumps, 2 and 3 plunger vertical belt pumps, 4 and 6 plunger geared belt pumps, 6 plunger differential piston belt pumps, 3 and 4 plunger engine-driven pumps, single steam cylinder pumps and duplex steam hydraulic pumps. Besides the standard styles which are shown in this catalogue, the company is prepared to furnish many other styles and sizes. Some very desirable features in the design of these pumps are the placing of all valves above the cistern top, where they may be readily examined, provision for easily taking up lost motion and the interchangeability of the smaller parts. The engravings in the catalogue are clear and the descriptions concise.

"Two to Fifteen Days' Pleasure Tours."—The passenger department New York Central & Hudson River Railroad have just issued one of their "Four-Track Series," No. 8, entitled "Two to Fifteen Days' Pleasure Tours." This book contains many illustrations of delightful summer resorts and some valuable information as to how to reach them by the New York Central. It also gives a very compact table of the time and rates of fare to one hundred and thirty popular resorts. This pamphlet will be a great help as a reference book to those who are contemplating a summer trip and will be sent free to any address on receipt of a postage stamp at the office of George H. Daniels, General Passenger Agent, New York Central & Hudson River Railroad, Grand Central Station, New York.

The Standard Pneumatic Tool Company of Chicago have just issued a "Paris Special Edition" circular No. 9, which represents in concise form a number of the "Little Giant" pneumatic tools and appliances which have just been placed on the market, among which are hammers for chipping iron and steel castings, single and double spindle boring machines, which are reversible at full speed, breast drills, screw feed drills and casting cleaners. These machines are simple in construction and are made expressly for hard service. Interesting installations of the machines are also shown in the circular.

Baldwin Locomotive Works.—A very handsome pamphlet has been sent by the Baldwin Locomotive Works, giving a general description, together with half-tone and line engravings of the express passenger locomotive built by the Baldwin Works for the French State Railways and the freight locomotive built for the Great Northern Railway of England, which are exhibited at the Paris Exposition. The catalogue also contains a report of the organization of the works and the steady yearly increase in the output. It is interesting to note that, while thirty years were required in building the first one thousand locomotives, almost the same number were built in the single year of 1890. Considerable space is given to illustrating steel-tired wheels which are manufactured by the Standard Steel Works. The engravings, with the exception of those of the wheels and tires, are excellent. These would be improved by clearer dimension figures. The press-work is of a high order of merit, which, added to the other good features, make it an unusually fine production.

Special Railroad Machine Tools and Appliances.—The Pedrick & Ayer Co. have just issued a new catalogue of 126 pages, illustrating special railroad machine tools and appliances of which they have been noted makers for many years. Some new tools are shown in connection with their compound locomotive cylinder boring bars and special Corliss valve-seat boring bars, and there is a radical departure from former catalogues in the way of a very complete line of pneumatic hoists, vertical and horizontal, with necessary appliances, as well as jib and traveling cranes, which are illustrated, together with some interesting installations of these hoists. Special attention is given to improved pneumatic riveting machines for light and heavy work, which this company has only recently put on the market. The catalogue also shows a change in the ratings of the company's machines, which gives the total effective pressure exerted on a rivet, with various sizes of standard frames, ranging from 43,000 lbs. to 188,000 lbs. exerted pressure on the rivet, also the length of the final effective stroke which carries this maximum pressure. Whether the rivet be 2½ ins. or 8 ins. in length, the construction of the machine takes up the difference instantly, without any adjustment, and then admits of so much effective stroke. In arriving at the effective pressure desirable for a given size rivet, the Pedrick & Ayer Co. state that it is the practice of the best concerns to make a distinction of 20 per cent. less pressure on rivets for structural work than for steam-tight work. Copies of this catalogue will be furnished upon application at the offices of the company, 85, 87, 89 Liberty Street, New York.

Bullock Type "I" Generator.—The Bullock Manufacturing Company, Cincinnati, O., have issued a pamphlet, Bulletin

No. 34A, illustrating and describing in detail their type "I" generator, which was designed for direct-connection, to steam or gas engines. It does not differ materially in general design from their standard belted machines, but is more compact, the general appearance neat and the outline very pleasing.

Electric Sprinkling Cars.—The J. G. Brill Company of Philadelphia have issued a circular No. 55, illustrating and describing the Brill sprinkling cars for electric street railways. These cars are built with tanks of 1,800, 2,500 and 5,000 gals. capacity. Their standard car has a tank of 2,500 gals. capacity. The sprinklers themselves have a special form of patent sprinkling head, which is very easy of operation, making it possible for one man to run one of these cars. Such sprinklers not only add to the comfort of the passengers, but keep grit and wearing substances from entering the bearings of the machinery, and they contribute to the economy of electric current, by reason of better contact between the wheels and rails.

"Early Tramroads and Railways in Leicestershire" is the title of a very interesting pamphlet, by Mr. Clement E. Stretton, Consulting Engineer, Saxe-Coburg House, Leicester, England. This rather concise history of the railways in Leicestershire, dating back as early as 1789, first appeared in the "Burton Chronicle" and is now put in pamphlet form for distribution. Mr. Stretton is well known as a locomotive historian and the world is indebted to him for many contributions to locomotive history.

## EQUIPMENT AND MANUFACTURING NOTES.

The Modoc Soap Co., Cincinnati, Ohio, have distributed handsome packages of playing cards contained in an attractive pocket case. On an additional card eight reasons are given why "Modoc Liquid Car Cleaner" should be adopted by railroads. This cleaner is advocated because it feeds and polishes varnish, it is a linseed oil preparation and does not contain benzine to injure varnish and cause rapid deterioration by evaporation. The fact that it is used on many of the best railroads and the superior appearance and greater durability of the paint and varnish are urged in strong claims.

Mr. W. D. Sargent, general manager of the Sargent Company, Chicago, returned from Europe Saturday, June 23, after a two-months' trip.

The Richmond Locomotive and Machine Works are shipping to the Paris Exposition, on the French Line steamer "Bordeaux," one 16-in. x 24-in. 10-wheel locomotive, built for the Finland State Railways. Their order was for ten engines, nine of which have already been shipped to Helsingfors.

Mr. J. W. Duntley, President of the Chicago Pneumatic Tool Company and also President of the New York Air Compressor Company, who has recently returned from Europe, brought with him an order for twelve air compressors for European shipment. The New York Air Compressor Company has also received an order for one of their compressors to be shipped to Yokohama, Japan.

The Ajax Metal Co. report greater activity than they ever experienced before and they are behind with orders in spite of running double night forces. One of their most popular products is "Ajax Plastic Bronze," which is attracting attention on prominent railroads. This company has for years combined a scientific study of bearing metals and the composition of alloys with their manufacture and to this fact a large part of their great success is due.

A branch office of the Magnolia Metal Company has been opened in San Francisco under the management and control of Messrs. Charles C. Moore & Company, Engineers. This firm has branch houses in Los Angeles, Seattle and Honolulu and by a recent contract the Magnolia Metal Company gives them the sole and exclusive agency for Magnolia Metal in the States of California, Oregon, Washington, Montana, Nevada, Idaho, Arizona, Utah and New Mexico; also in the Hawaiian Islands. The firm is well known throughout this territory and the connection will undoubtedly be a very valuable one.

Mr. J. W. Duntley, President of the Chicago Pneumatic Tool Co., before his recent return to this country, cabled from Europe as follows: "I have to report fresh orders for 1,000 tools." This is a remarkable order which reflects the condition of the demand for pneumatic tools abroad. The progress of this country in their adoption was very unusual, but in Europe it is phenomenal.

The Sargent Co., 675 Old Colony Building, Chicago, have issued a pamphlet entitled Cast Steel Wheel Centers, in which a number of designs of driving wheels, made by them, are illustrated from working drawings. These are interesting, because they show the driving-wheel practice of a number of roads and they also illustrate the designs which these manufacturers approve. The Sargent Co. recommends making the rims solid and splitting them. They also recommend patterns in which cores for hubs and counterbalance pockets are omitted. Correspondence on the subject of cast steel wheel centers is invited. The pamphlet is valuable as a record of practice, and gives the weight and dimensions of 17 wheel designs.

The Foos Gas Engine Company, Springfield, O., a short time ago received a letter from Messrs. Bollinger Brothers, Engineers and Contractors, of Pittsburg, from which the following is quoted: "After some very unsatisfactory experience with two gas engines, wrestling with them for several months, we were compelled to throw them out, placing in one of your 8-h. p. gas engines, which has been at work now for some eight months, and always doing its work in a very satisfactory manner. We are much pleased with the performance of this engine, believing there is no better engine made." This is a satisfactory and pleasing endorsement of the Foos gas engine. The builders have had thirteen years' experience in the construction of gas engines.

It is believed that the admirable properties of mineral wool for railroad use, while appreciated by many, are not as well known as the qualities of the material deserve. It is a clean, inexpensive, non-combustible heat, cold and sound insulator and is specially well adapted for use as a filling for passenger car sides, ends and floors. It is equally valuable as an insulator for refrigerator cars, where its permanent and practicably indestructible qualities are especially appreciated. It does not decay or solidify, when properly packed, and its relatively light weight is also favorable. Mineral wool is also used very successfully as a covering for exposed water tanks, for steam boilers and steam pipes. Information may be obtained from the United States Mineral Wool Co., 143 Liberty Street, New York.

The Clayton Air Compressor Works, 26 Cortland Street, New York, have recently perfected a new type of Duplex Belt Air Compressor. These machines are built in small and intermediate sizes and embody all of the latest improvements. Although their facilities have been doubled, it has only been by most diligent and careful management that they have been able to make reasonable deliveries. They have recently equipped five plants of the Brooklyn Heights Railroad Company with compressors and pneumatic hoists; also the Grasselli Chemical Company, General Chemical Company, De La Vergne Ice Refrigerating Machine Company, Union Brewing Company, Gill Machine Works, White Machine Shops, etc. Their export trade has more than doubled and they are shipping their product to England, Germany, Russia, France, Italy and Japan. Many orders are being received from Mexico and South America. Information concerning their product will be furnished by this company upon application.

An apparently successful combination of the Janney coupler with the hook coupler, commonly used in England, is now being tried experimentally on the Great Northern Railway, England. As illustrated in "The Engineer," the drawbar terminates at its outer end in a hook for the ordinary English chain coupling. Over this hook a Janney "M. C. B." type of coupler is hinged in such a way as to be raised and held in place by a pair of pins when wanted. When the hook and chain are wanted the coupler head is dropped out of the way and the hook exposed for use. The arrangement seems to be giving satisfaction.

## MASTER CAR BUILDERS' ASSOCIATION.

### Thirty-fourth Annual Convention.

### Abstracts of Reports.

### SIDE BEARINGS.

Committee—J. W. Luttrell, B. Haskell, H. M. Pfleger.

#### Standard Spread.

In the replies received to a large number of inquiries issued, in securing information and data of results obtained from the general and customary practice in the use of side bearings, the importance of a standard spread seemed to be regarded secondary to the necessity for clearance. Although this is a feature of much importance, it was found that the distance from center to center of the bearings, as practiced by a large number of companies, did not vary sufficiently to occasion controversy or affect the results in service; the difference being from 53 to 62 in.

It is believed that the most satisfactory location is just within the arch bars, or about 60 in. from center to center of the side bearings. A large number of companies at present specify this dimension, and inasmuch as the total variation in nearly all cases is small, there would probably be no difficulty in establishing it as the standard. The approximate uniformity in this measurement is taken as an evidence that it is recognized as

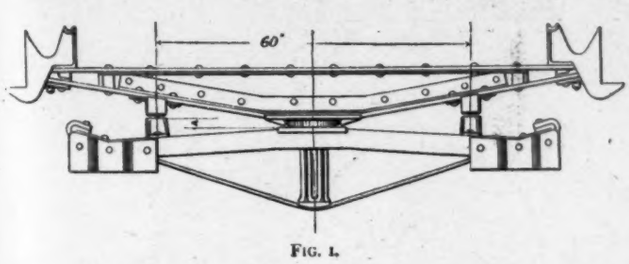



FIG. 1.

the best practice, and your committee recommends that 60 in. be adopted as the standard.

In agreeing upon a standard spread your committee would also emphasize and advocate the adoption of a standard height from top of bottom side bearings to the bearing surface of the bottom center plate. While not affecting the design of the bearing itself, it will permit the interchangeability of trucks where the standards have been observed.

By reference to Fig. 1, which shows a body and truck bolster of metal structure, the standard spread as recommended will be found expressed, the letter "A" indicating the height from bearing surface of bottom center plate to the top of bottom side bearings.

#### Side Bearing Clearance.

In view of the discussion which has arisen at different times in the past, relating to side bearing clearance and the advisability of carrying the weight of car body and load on the center plates entirely, or equally distributed on the side bearings and center plates, it was somewhat of a surprise to find expressed in the replies to your committee's circulars of inquiry, a unanimous opinion in favor of carrying the load on the center plates, and, with one exception, a clearance between the side bearings advocated. As these recommendations represent the results of long experience, observation and tests, it would seem unnecessary to go into lengthy detail as to the relative merits of the two conditions. However, to add more information, if possible, and confirm the prevailing opinion, your committee conducted a series of tests with a view of determining the relative resistance under the different conditions.

A box car of late design, with a capacity of thirty tons, was used. The body bolsters were of the double leaf iron type, with a 10 by ¾-inch top plate and 10 by ⅞-inch for the bottom plate; the regulation cast-iron thimbles being interposed between the members at the sill bolts, and with a cast-iron filling block at the center. The car had rigid trucks, with Simplex truck bolsters, and a 15-in. channel-iron spring beam. The weight of the empty car was as follows:

| | Pounds. |
|---|---|
| Body | 18,700 |
| Trucks | 11,400 |
| Total weight | 30,100 |

The car was loaded with one hundred car wheels, weighing 60,800 lbs.; the weight on each truck being equalized by placing fifty at each end of the car. Adding the weight of the car body will give a total weight of 79,500 lbs. on both center plates. The total area of contact surface of center plates was 56.56 sq. in., which, with the weight stated, is equivalent to 1,405 lbs. per square inch on the bottom center plates, with the car body clear of the side bearings.

An inclined track with a grade of 4 ft. in 100 ft., having a 15-degree curve at its base and leading to a straight track, was selected to make the tests. In all cases the loaded car was placed on the incline, with the center line of the front pair of wheels at a point 125 ft. from beginning of the curve, as shown in Figs. 2 and 3, where it was held with the hand brakes.

#### Test with Clearance Between Side Bearings.

In the first test the car was adjusted empty to give a clearance of ⅜ inch between the side bearings. After the car was loaded there was no appreciable deflection. Thus the entire weight of car body and load, or 79,500, was imposed on the center plates, that is, 39,750 at each end. The car was placed on the incline at the point stated; the brakes were released as quickly as possible, whereupon it started and moved rapidly until the curve was reached, where the speed slackened; after reaching the straight track the car resumed its normal position with respect to the side bearings, and traveled 345 ft. before coming to a stop. The rounding of the curve seemed to be attended with but little friction, and in riding on the car there was no perceptible shock or straining.

#### Test with Weight Carried on Side Bearings and Center Plates.

The height of the side bearings was then adjusted to distribute the weight on the center plates and side bearings as equally as possible. The contact area of the side bearings was 15 sq. in. each or 60 sq. in. for the four; adding the area of the center plates gives a total of 116.56 sq. in. carrying the car body and load, which is 682 lbs. for each square inch. In each instance the car rode very hard, and the sudden slackening of speed when the curve was reached produced considerable shock and straining to both body and trucks.

#### Test with Roller Side Bearings.

The car was then equipped with anti-friction side bearings having two chilled iron rollers to each bearing, connected with top and bottom seats with chilled surfaces for the movement of the rollers. The adjustment was such as to produce equal weight on center plates and side bearings. The freedom of movement seemed to be about the same as in the first test with a clearance between the side bearings. The car was then raised off the side bearings ⅛ inch. This did not result as satisfactorily, as indicated by the distances traveled.

There was no difference noticed in the conditions, when the car rounded the curve, compared with the preceding test.

For the convenience of comparison, a table is given herewith summarizing the results of each test, expressed in feet traveled on the straight track after the car had traversed the curve:

| | Side Bearing Clearance. | Weight on Side Bearings. | Anti-friction Weight on Bearings. | Anti-friction ⅛ inch free. |
|---|---|---|---|---|
| | Feet. | Feet. | Feet. | Feet. |
| First trial | 345 | 203 | 325 | 284 |
| Second trial | ... | 197 | 335 | 346 |
| Third trial | ... | 176 | 372 | 303 |
| Fourth trial | ... | 212 | 350 | ... |
| Average | 345 | 197 | 345½ | 311 |

The results of the tests would indicate that the most satisfactory condition for service would be to have the weight carried on the center plates, and with a clearance between the side bearings. While the anti-friction bearings under certain con-

FIG. 2.

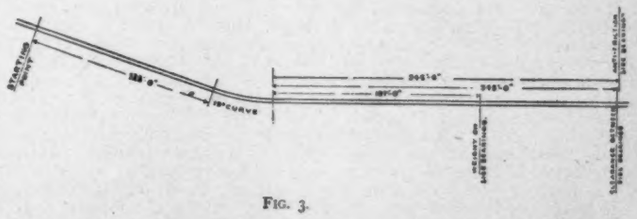


FIG. 3.

ditions produce an average slightly better, the difference is insignificant. Furthermore, it would appear that a correct adjustment is necessary, otherwise the results would not be as satisfactory.

The fundamental requirement in maintaining this clearance is a construction of truck and body bolsters which will insure a minimum amount of deflection. Your committee is of the opinion this can not be obtained with wooden bolsters, as the possibilities of deflection in their use demands a greater clearance at the outset, and which, unless given frequent attention, gradually disappears. It is believed the best results can only be obtained from a good form of metal bolster.

The extent of contact surface of center plates is also considered an important factor as influencing the proper movement of trucks in traversing curves and in relation to the side bearings. It is well understood that safe practice opposes excessive weight for each square inch of bearing surface; and that better results will be derived from center plates with large area than if too small. The ones used under the car in making the tests had a bearing area of 28.28 sq. in. each, producing 1,405 lbs. per square inch with a car body and load of the weight stated.

Your committee considers this plate too small, and is of the opinion that the size should be such as will impose about 800 lbs. per square inch of contact surface.

As to anti-friction side bearings, your committee has not been able to satisfy itself that this type of bearing has attained a sufficient degree of perfection, as far as can be learned, to insure superior results compared with the present practice, considering the increased cost, especially in freight-car construction. Theoretically, a device which will facilitate the movement of the truck when traversing a curve would be of advantage; but from the information obtained, it is demonstrated that the rollers, which enter into the construction of nearly all anti-friction side bearings, soon become flattened and then the bearings are of no more value than the older design, if as good.

In concluding its report, your committee desires to state that after careful investigation and inquiry among a large number of companies, it is convinced that the best results can only be obtained from a proper clearance between the side bearings.

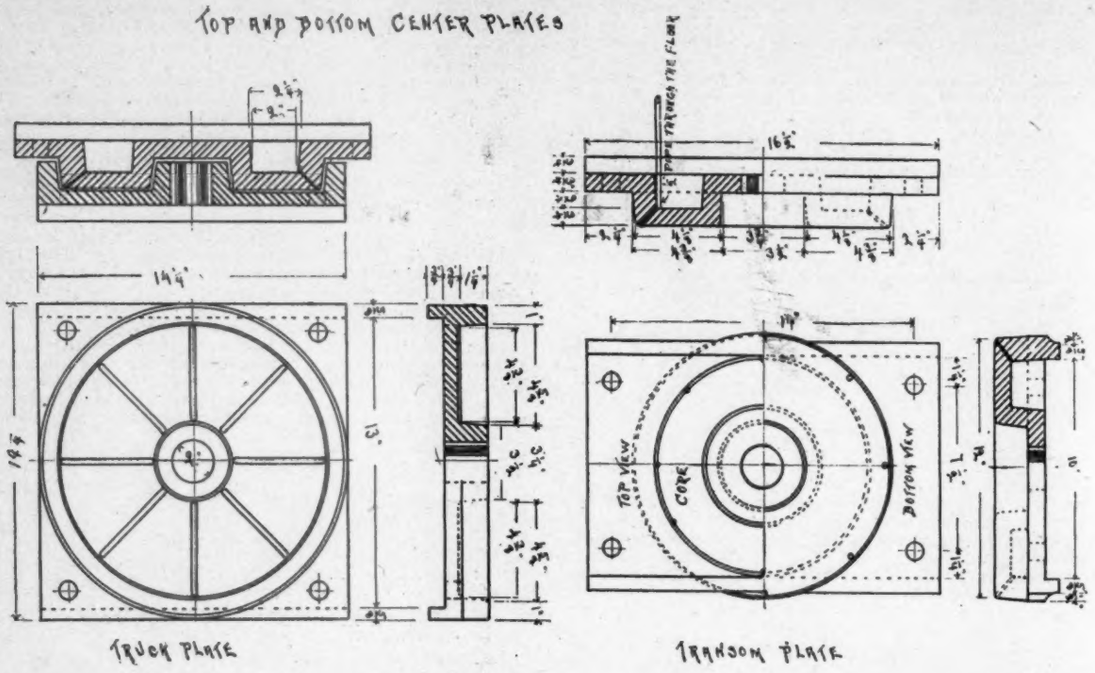



FIG. X.—Center Plate for 60,000-pound Car.

In fact it developed that an important line was refusing cars unless there was such clearance, doubtless an evidence that it is considered a question of safety under some conditions.

## STANDARD CENTER PLATES.

Committee—R. H. Johnson, G. T. Anderson, H. L. Preston.

From the data presented by the replies from members (Not reproduced in this abstract.—Editor), the Association can see how varied are the opinions of those constructing or maintaining cars. Your committee feels bound to call attention to those answers wherein the blame or failure of pressed steel or malleable iron castings are attributed to light construction.

Another feature we would mention is shown by steel and malleable center plates crushing under load and becoming so fixed that they will not permit the car trucks to curve. This, we believe, is brought about by the excessive length of pressed steel, malleable or cast iron center plates. It is an established fact that wooden bolsters, or wood and iron combination bolsters, will spring, and it necessarily follows that the long center plate must spring with the bolster. If of light construction, this curvature will necessarily force the outer edges of the center plate inward. This action will nip the bottom section fast, causing a rupture, either by separation of the lower or bearing part of the center plate, or where it curves to form the circle. This would explain the many answers claiming that breakage was due to load, and bottom or top section crushing out. Your committee, therefore, would advise shortening the bearing of center plate as much as possible, thus reducing the bearing surface lengthwise of the bolster.

The next question pertains to the dimensions given for bearings. There should be some relative dimension governed by load for center-plate construction, and without going into a scientific analysis will call your attention to a few conditions that may be readily followed and give reasonably good results.

First. Those loading cars should have impressed upon their minds the importance of loading the cars as evenly as possible, so that the cars will be, as the ship loader would call it, "trim." Assuming that the car is loaded evenly and that the average width is about eight feet, taking the load on one center plate to be about 40,000 lbs. will give for each foot of width of car about 5,000 lbs. Assuming further, that 400 lbs. to the square inch of surface should be the general rule for center-plate service, there will be required a center plate about 12 in. in diameter, less the space of 2 in. for king bolt and 1¼ in. for inside ring, which would give about 100 sq. in. for bearing surface. The surface of this center plate being flat, by the aid of an emery wheel it could readily be smoothed off. This would give, comparatively, a smooth surface upon which the 40,000 lbs. would rest. Now, let us say that some outside force had caused the car to list; for instance, entering a curve. While upon the curve, the natural tendency would be to throw all the weight upon the outer edge of the 12-in. center plate, and the result is that the center of load bearing has moved over 6 in., resulting in five-eighths of the weight being on one side of the bearing point, equaling about 25,000 lbs. The natural tendency would then be for the car to re-establish its normal or vertical position at the earliest possible moment by overbalancing the remaining three-eighths of the weight on center plate.

From such a center plate there would be no question but that it would carry the weight of the car and maintain, under reasonable conditions, the vertical position required, thus relieving the side bearings of all duty excepting that of a safety appliance to catch the car in time to prevent damage from any sudden shock in a lateral direction.

The second condition is that of the center plate shape. It is understood that our metal bolster-making friends claim a large saving to train friction by the use of their bolsters from the fact that the metal bolster will maintain its general contour under any load, thus assuring, under general conditions, that the car will not ride on its side bearings. Such being the case, on what principle of adjustment do our builders construct a ball or dished-shaped center plate? It is evident that a ball surface or sphere offers the least resistance to a rolling motion, and there is no constructor who would believe that a car, mounted on two 20-in. balls, would maintain its position going around a curve at a rate of 20 miles per hour for as many minutes. That they fear displacement is shown by the construction of a ring at the bottom of the circle that limits, if it does not prevent, the rolling motion that they expected to receive when the ball or center plate was evolved.

As long as the inner ring remains in position, reinforced by the king pin, the car retains its position upon the truck, but should sufficient force be exerted to cause the breaking of this ring, the same force will break the king bolt and cause displacement of the center plates.

Another feature in this construction that is very much in evidence is the listing of the cars to one side bearing, then to the other. With a ball-bearing center plate, if the car should list, what is there to cause the car to assume a vertical position? Must it not remain upon the side bearing until the trucks find some high place on the rail to enable it to toss the car over to the opposite side bearing? If this action is a fact, then is it not also a fact that the car must be literally tossed from one side bearing to the other or remain permanently upon one side bearing, increasing flange wear?

As there is nothing to prevent the rolling motion to this ball-bearing center except a tight fit around the center ring or king bolt, therefore what advantage can be claimed in a construction that necessitates a condition to prevent the natural result one must expect from a curve construction, which thus nullifies

the advantages that the metal bolster makers claim in their construction of rigid bolsters.

We attach, for inspection, various blue prints sent us by those answering our questions, and have here a wooden model showing a center plate with oiling device. Also, would call your attention to figure marked "X" that will show the general dimensions of a plate for 60,000 lbs. capacity car, having about 100 sq. in. of surface to carry about 400 lbs. per square inch; also grooves in male face to assist the rapid distribution of the oil over the face of the male center plate. The oil reaches the recesses on the top of said plate from within the car through a ½-in. pipe, and the six holes through the plate at the edge of same allow the oil to escape into the grooves and over the lower center plate surface.

## AIR-BRAKE APPLIANCES AND SPECIFICATIONS FOR AIR-BRAKE HOSE.

Committee—A. L. Humphrey, A. M. Waitt, W. H. Marshall.

Your Committee on Air-Brake Appliances and Specifications for Air-Brake Hose sent out a circular of inquiry regarding any suggested additional standards for air-brake appliances, slack adjusters, additional air-brake power upon heavy-capacity cars and in connection with specifications for air-brake hose. Only eight replies were received to the circular from representatives of railroads, showing apparently that very little vital interest is taken in this subject at the present time.

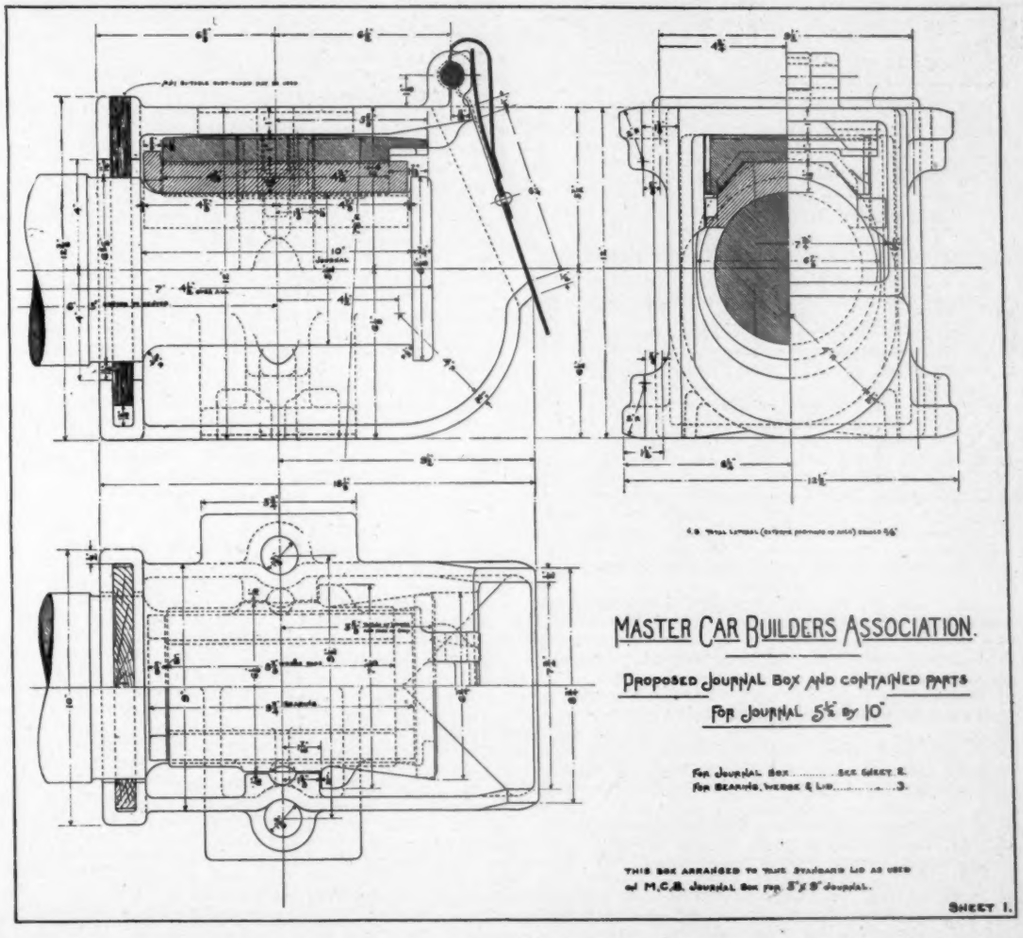
It seems to your committee that those in charge of motive power and car departments on railroads should see that employes who have to do with the repairs, maintenance and adjustment of air brakes on cars give more attention to the importance of a correct piston travel in order to have the brakes operate as nearly as possible at their point of maximum efficiency.

Your committee would call attention to the great neglect regarding the proper care of air-brake cylinders on freight cars. Many seem to think it simply necessary to remove the oil plug in the cylinders and put in a quantity of inferior-grade oil, leaving the packing leathers oftentimes hard and badly cut or worn. Experience seems to show that a light grease is more advantageous to use than a heavy oil, and it has also been found desirable to have the cylinders made without any oil hole, thereby making it necessary, whenever the cylinder is to be oiled, to take off the cylinder head, and so that at the same time the lubricating is done the packing leather and rings and the inside of the cylinder will receive proper attention in the way of cleaning, and any other necessary repairs required.

Your committee believes more attention should be given to reducing the number of elbows that are found in the piping of many cars. Every sharp bend in the pipe means a retarding of the action of the brake and added friction in the movement of the air through the pipes. As far as possible, in designing air-brake piping for cars, "ells" should be eliminated and long, easy bends substituted.

It has been suggested by one of the air-brake companies that on Plate 9 of the Association Standards for Air Brakes on Freight Cars, the dimension showing the location of angle cocks should be given, as well as the angle at which this cock should stand with reference to the vertical. Your committee would recommend that this feature be referred to the Committee on Supervision of Standards, for them to consider and make definite recommendations at our next convention in 1901.

Your committee does not believe that it would be advisable to continue a general Committee on Air-Brake Appliances and Specifications for Air-Brake Hose at the present time, but there would seem to be an opportunity for a special committee to take up the subject of The Use of Slack Adjusters and the Consideration of the Necessity of Additional Brake Power on High-Capacity Cars, together with the subject of Specifications for Brake Beams for High-Capacity Cars.




It has also been recommended by some that further consideration be given to the subject of Air-Brake Hose Specifications by a committee who will take up this subject exclusively.

These suggestions and the information given above are respectfully submitted.

## JOURNAL BOX, BEARING AND WEDGE FOR CARS OF 100,000 POUNDS CAPACITY;

Also

## JOURNAL BEARING AND WEDGE GAUGE FOR CARS OF 80,000 AND 100,000 POUNDS CAPACITY.

Committee—Wm. Garstang, J. J. Hennessey, W. H. Marshall.

Your committee, instructed to prepare plans for a journal box, brass and wedge for 5½ by 10 in. axles for cars of 100,000 lbs. capacity, and limit gauges for journal bearings and wedges for cars of 80,000 and 100,000 lbs. capacity, submits drawings for these parts for your consideration:

In preparing these plants it has been the aim to design the parts, as far as possible, with a view of using present standards without detriment to the design. This has been found practicable with regard to the journal-box lid only. The present standard lid for 5 by 9 in. boxes is of sufficient size to cover

the necessary opening in the proposed 5½ by 10 in. box, by reducing the overlap on each side.

The design of the brass is made with a view of reducing the non-wearing parts to their minimum weight and size consistent with the required strength, and to increase the bearing and wearing surface as much as possible.

The size of the box is kept as small as possible to decrease weight and increase its strength, with special reference to making the box of sufficient capacity for oil and waste, and at the same time limiting that capacity to an amount that will be sufficient for proper lubrication, but will not admit of a wasteful or unnecessary amount.

We recommend the box to be made with circular bottom, as it has all the advantages that have already been discussed relative to that point; at the same time it is recommended to allow the square bottom to come under the list of standards for any who may prefer this bottom, either for a larger oil capacity or other preference.

We desire to call attention to the fact that the box, wedge and brass as described will interchange with the box, wedge and brass now in use on about fifteen thousand 100,000-lb. capacity cars, which are practically all the cars of this capacity now being operated.

In the preparation of the drawings the notations made on them allow of the same elasticity in preference to materials, etc., as was decided and adopted in the case of the same parts for the 80,000-lb. car.

(To Be Continued.)

## AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.

### Thirty-third Annual Convention.

### Abstracts of Reports.

### POWER TRANSMISSION BY SHAFTING VS. ELECTRICITY.

Committee—George Gibbs, F. Mertsheimer, William Renshaw, W. A. Nettleton, R. A. Smart.

A comparison of the relative advantages of electric and shafting driving for shop use may be made under the following general headings:

1. Relative economy in cost of power itself.
2. Relative convenience of operation and installation.
3. Relative effect upon shop output and cost of labor.

Referring in detail to the scope of these considerations:

1. Economy.—This has been taken to comprehend only the relative cost of operating the two systems, including expense for fuel, attendance, repairs, interest on investment and depreciation. It is the reason most generally advanced for the installation of electric power, but can only be the controlling one where the cost of power is a large proportion of the shop running expenses.

In order to compare the relative efficiencies of engine and electric transmission, it will be necessary to subdivide the character of shop plants somewhat. To do this completely would lead to endless complication, but for present purposes the typical plants are:

1. Shop plant in which each building has its own power plant.
2. Shop plant in which all buildings are furnished with power from a central source.

The manner of connection from the prime mover to the tools may be assumed, for an extreme comparison, in either of two ways, namely: (a) shafting method; (b) individual tool-driving method.

Taking the first condition, the average efficiency from engine to tools for steam engine transmission is shown elsewhere to be 50 per cent.; for electric transmission, under condition "a," the shafting losses will be reduced by splitting up long lines and by avoiding cross-belting, so that they will not exceed 20 per cent., or an efficiency of 80 per cent.; and in the electrical elements, as before shown, the efficiency from engine to shafting is 65 per cent.; therefore the final transmission efficiency will be, $80 \times 65 = 52$ per cent., as against 50 per cent. in the purely mechanical method; or, practically, a stand-off. Under condition "b," much less shafting will be employed, and the electrical portion may also show a better all-day efficiency, under certain conditions, by the shutting down of idle machines—say, a shafting efficiency of 90 per cent. and an electrical efficiency of 66 per cent., or a resultant of 60 per cent.—showing a small gain for the electrical method.

Taking the second condition and assuming an unfavorable condition for shafting transmission, as in case of a shop having each building with its own boiler plant and one or more engines, and compare this with a case of a central power plant for electric transmission to all buildings, the possible fuel saving in the latter arrangement will result first, from some small saving in power required for each individual building, as before shown, and second, from some very considerable saving due to the better efficiency of a large engine and boiler plant over that of several small ones. In extreme cases, where large condensing engines displace small non-condensing ones, and in large stations having a uniform load, the fuel saving may readily approximate 33 1/3 per cent., as is shown in an actual case cited elsewhere.

Attendance.—The item of attendance will next be considered. It is made up of three classes of labor—engineers and firemen; care of shafting and belting; electrical repairs. In an electric system the costs can be reduced by consolidating the engine and boiler plants and by the elimination of large and heavy belts, large shaft bearings and the consequent danger from overheating, reducing labor probably one-half; but a new item of expense in care of electric machinery will be introduced, which will about offset the other items, leaving the whole attendance bill practically unaffected by the introduction of electric shop power in plants of any considerable size.

Repairs.—As to repairs of shafting and belting it is difficult to obtain accurate data, the record of these items being seldom kept separately in shop accounts. The records of one large establishment have, however, been examined by your committee and the saving found in these items, under the electric driving system, is found to be more than sufficient to pay for all repairs to motors and lines. Thus the conclusion seems justified that the repair item will not be materially different under either system of driving.

Interest.—The remaining items of power-cost are depreciation and interest on investment. It is difficult to institute a fair basis of comparison between the first cost of an electric and a steam transmission plant, for the reason that the results sought to be accomplished by the former provide additional shop facilities, and are therefore not rightly chargeable in a substitution sense. Considering, however, the case of simple substitution in a single shop, where the power plant and arrangement and number of tools is retained as before, electric driving is certain to involve a largely increased first outlay—approximately double that for shafting method. But in a modern shop plant other considerations are the guiding ones in selection of the power system, such as the possibility of labor-saving devices, cranes, etc., and the greater cost of the electric system becomes a rightful charge against the advantages so obtained.

Dropping, therefore, any attempt to draw a strict comparison between first costs, it may be said that in estimating the total cost of power machinery it is usual to include an allowance for interest and for a sinking fund, with which to replace the plant when its utility is no longer on an equality with best practice. These items are generally figured together at 10 per cent. on first cost, a sum amounting roughly to one-fourth of the total running expenses of the power system.

Convenience and Shop Output.—These considerations are so closely inter-dependent that they can best be referred to together.

The ordinary shop plant with steam power transmission, both in the arrangement of building and of machines, is the slave to the limitations of this system; it must be laid out so that the shafting and engine connection is as direct and simple as possible; the machines must be compactly arranged in parallel lines, and the ceilings and columns designed with special reference to shafting supports. In other words, the tools must be installed with first reference to the application of power and not, as should be the case, with reference to handling the work to best advantage. Handling operations are of necessity largely by manual methods, and the shop buildings even must be located with first view to getting the power to them with the least awkwardness and expense.

While generalizing in this manner, your committee has not lost sight of the fact that handling and transferring machinery may be operated by other means than electricity, but it is equally true that devices of this nature are of limited practical application, and the broad fact remains that electricity is to be credited with ushering in a new era of labor-saving shop devices.

Electrical transmission places no restriction on the location of the machines, and each shop may be planned with a view to handling its product with least waste of labor and with greatest convenience of access to the tools. These may even be transported from place to place to the work; further, the partial or entire absence of overhead line-shafting insures better lighting of the shop and conduces to cleanliness. These factors promote cheerfulness and an improvement in both quantity and quality of output.

The clear head room permits the universal application of various forms of traveling cranes for serving the tools and for conveying operations, furnishing the most efficient means yet developed for increasing shop economy, and, as a means of communication between buildings, electric cranes and transfer tables have advantages over appliances of the same nature driven by steam and air.

Special Appliances.—In these electricity shares a large field with compressed air. It must be admitted that air devices have up to the present time received most attention at the hands of the railway mechanic, a fact in large part due to the lack of practical knowledge of the electrical specialist and to the greater cheapness of air tools. With, however, the general introduction of electric shop power plants and the better acquaintance of practical men with the agency, an extensive application of electric labor-saving devices is certain to result.

Flexibility.—The extension of a shop building or the tool equipment under the shafting system is generally a matter of much difficulty, and the attempt to add to such a plant often results in inconvenient crowding of the tools or to an overloading or complication of the shafting system, a fact which fully accounts for the extremely poor efficiency sometimes quoted for shafting transmission. In an electric system, on the other hand, great flexibility in extension is secured, as new buildings may be placed in any convenient position and additions made to the driving system without affecting the intermediate links.

TABLE No. 1.—POWER REQUIRED FOR MACHINE TOOLS.

| Tool. | Nature of Work. | Horse-Power Required. | | | | Remarks. |
|---|---|---|---|---|---|---|
| | | Empty. | Light Load. | Full Load. | No. of Cutters. | |
| 70 in. wheel lathe | Wheel center | ..... | 4.4 | 7.9 | 2 | Light cut. |
| | 32 in. wheel center | ..... | 4.7 | 5.8 | 2 | ⅛-in deep cut. |
| | 56-in. wheel center | 1.5 | 5.2 | 6.2 | 2 | |
| Horizontal lathe | 56-in. wheel center | ..... | 4.3 | 7.1 | 1 | ¼ in. deep cut. |
| Large double frame planer | Two frames | 11.0 | ..... | 21.6 | 2 | ½-in. deep cut. |
| Slotter, 18 in. stroke | Frames | 2.3 | 5.0 | 10.3 | 1 | Heavy cut. |
| Slotter, 12-in. stroke | Wrought iron, 6 in. thick | 1.5 | 2.1 | 6.5 | 1 | |
| 36-in. planer | Frames | 3.4 | 4.2 | 7.4 | 1 | |
| | | 3.4 | ..... | 11.3 | 2 | |
| Drill press | 1-in. drill, wrought iron | .97 | 1.94 | 2.9 | 1 | |
| | 1¼-in. drill, wrought iron | .97 | 1.92 | 2 2 | 1 | |
| | 2¼-in. drill, wrought iron | .97 | 1.94 | 2 85 | 1 | |
| Boiler-plate shears | ⅝-in. plate steel | 3.5 | 6.0 | 19.0 | 1 | |
| Boiler-plate rolls | 1-in. by 10 ft. 6 in. long, steel | 4.5 | 11.4 | 19.8 | .... | |
| Jib crane, 10 ton, 10 h.-p. motor | Lifting 10 tons | 1 2 | ..... | 13.0 | | |
| | Lifting 7 tons | 1.2 | ..... | 11.0 | .... | |
| Jib crane, 6 ton, 8 h.-p. motor | Lifting 6 tons | 1.2 | ..... | 11.8 | .... | |
| Traveling crane, 5 ton | Lifting and carrying 4 tons | 11.9 | ..... | 19.3 | .... | |
| Planer | Empty | 3.4 | ..... | ..... | .... | |
| | 1 tool | ..... | ..... | 7.4 | .... | |
| | 2 tools | ..... | ..... | 11.0 | .... | |
| Shafting | Empty | 15.0 | ..... | ..... | .... | |
| | 6 planers | ..... | ..... | 20.0 | .... | |
| | 4 milling machines | ..... | ..... | 26.0 | .... | |
| | 2 lathes | ..... | ..... | 30.0 | .... | |
| | 1 buff wheel | ..... | ..... | 34.0 | .... | |
| Planer and siding machine | 6-in. oak flooring | 8.0 | ..... | 32.0 | .... | Top and sides planed. |
| 24-in. planer | 12 in. yellow pine | 2.5 | ..... | 11.0 | .... | Top only. |
| Molding machine | 6½-in. yellow pine carlin | 1.5 | ..... | 8 5 | .... | 4 sides. |
| Daniel 30 in. head planer | Oak tender end sill | 3.7 | ..... | 8.8 | .... | Cut ⅞ in. off top |
| 3-spindle boring mill. | Oak, 2-in bits | 0.5 | ..... | 2.5 | .... | |
| Large tenoning machine | Oak end sills | 3.0 | ..... | 7.0 | .... | ¾-in. x 5-in. x 10-in. cut. |
| Circular rip saw, 28 in diameter | Oak, 9¼-in. by ¼-in. cut | 1.5 | ..... | 20.0 | .... | |
| Band saw plate, 1½ in. wide. | Oak, 12 in. thick | 1.5 | ..... | 6.0 | .... | |

Speed Control.—The case of speed control between wide limits of certain types of electric motors is a valuable feature and will result in more frequently securing a greater adaptability of the tool to the work than is possible where a change in speed involves stopping the tool and shifting belts and gearing.

Increase in Output.—This constitutes, in the opinion of your committee, the chief claim of electric transmission to the attention of shop managers, and it follows from the previously mentioned facts, as, by the use of electric handling devices, the tool is quickly served with its work and the product placed in the most favorable position for operating upon and idle time cut down, and, by independent driving, the capacity is increased by reason of the perfect control of speed possible.

## POWER REQUIRED TO DRIVE MACHINE TOOLS.

Data for power required for shafting and for certain tools may be found scattered through the transactions of various engineering societies, especially in the papers of Professor Benjamin, in the proceedings of the American Society Mechanical Engineers, 1896 and 1897, which give valuable figures; but the amount of exact information attainable anywhere is not very considerable. In the nature of things, figures for frictional losses in shafting must be exceedingly variable, and under the plan of connecting the shop power system to one main driving engine, there is no ready means of analyzing the figure of engine-indicated horse-power to determine the consumption of any particular section of shaft or of a single tool.

With the introduction of electric driving, however, the subject is becoming better understood, as it is a simple matter to connect a test motor to a shaft or tool and thus obtain figures from which to design a power plant for maximum efficiency.

Electric Efficiency.—An electric transmission plant varies in efficiency as follows:

| | |
|---|---|
| Generators | 86 to 90 per cent. |
| Transmission lines | 90 to 95 per cent. |
| Motors | 78 to 90 per cent. |
| Total final efficiency | 62 to 77 per cent. |

The above are figures for full loads on the different elements and the variation arises from the difference in sizes of units employed and in line losses assumed. At partial loads the machine efficiencies will drop, but the line efficiency will increase, so that the resultant will be nearly independent of the load. In fact, it is generally possible to shut down many of the separate motors when operating the plant at partial load, and the efficiency of transmission may thus actually increase under such conditions. In an average size of railway shop plant a resultant all-day efficiency of 65 per cent. from the engine to the motor pulley may be assumed.

Shafting Efficiency.—The average friction horse-power in heavy-machinery shops to drive belts and shafting, from engine to tool pulleys, as given by various authorities, varies from 40 to 55 per cent. of the total power used, and perhaps the round figure of 50 per cent. is as near the correct general average as the data will permit. Considering a separate shaft only, with compactly arranged tools, a better efficiency than the above can be assumed, and your committee concludes from a number of experiments with electrically driven line shafts that 20 per cent. fairly represents the average loss in shaft and counter-shaft bearings and belts on the tools, or an efficiency of 80 per cent.

Some authorities attempt to express the actual horse-power lost in friction per 100-ft. length of shafting and per countershaft and per belt, but while figures of this kind would be useful if approximately correct even, your committee has been unable to check them closely enough to feel warranted in quoting them.

As a rough guide in laying down shop power plants, it would appear that the horse-power of generating station required per man for railway shops will average about 4 h. p.

Table No. 1 gives a few examples from tests of the power required to drive typical railway shop tools, both for iron and wood working. The greater number of these results for metal-working tools were taken from tests at the Baldwin Locomotive Works, and for wood-working tools from Pennsylvania Railroad Company's tests.

### Suggestions Upon the Manner of Installing an Electric Transmission Plant.

System.—Both direct and polyphase alternating current systems are applicable for shop use, and each system has its advocates among electrical engineers.

For long-distance transmission, say one mile or more, alternating transmission is almost a necessity; for shorter distances, and in cases of isolated plants in compactly grouped railway shops, the direct-current system can be employed without any practical disadvantages in waste of power in transmission lines.

Mechanically the induction type of alternating motor has great advantages in its simplicity and the absence of rubbing contacts. When it is said that probably 90 per cent. of all direct-current motor repairs are to commutators and brushes, the importance of this statement is clear. A further advantage in the induction motor is the strong mechanical design of the revolving element. This is built up of heavy copper bars firmly bolted to a cast center. The direct-current motor, on the other hand, is a complicated assemblage of small wires, made additionally weak by the necessities of installation.

The disadvantages of the alternating-current motor are its high speed and the fact that it is essentially a constant-speed machine. For driving line shafting, a constant-speed motor is entirely satisfactory, but for independent tool driving a variable-speed motor has unquestionable advantages.

If the alternating system is to be adopted, it is important to specify that the motors shall be of the "induction" type, as this is the only variety which is at all applicable for shop uses.

A further element of importance in the alternating system is that of "frequency" or number of alternations of the current per minute. It is difficult to give a positive recommendation as to the proper frequency without qualifications. Realizing, however, the importance of standardizing apparatus, your committee venture to suggest the specification of "3,000 alternations per minute" for adoption in railway shop plants. Alternating motors of this frequency are now in general use and have the very great advantage of fairly slow speed.

Voltage.—Direct-current generators are built for 125, 250 and 550 volts pressure, which, allowing for ordinary losses in lines, corresponds to motor pressures of 110, 220 and 550 volts respectively.

The 220-volt direct-current motor is practically the standard for shop purposes; the 550-volt motor is used for railway pur-

poses, but this pressure is indescribably high for shop use. Incandescent lamps may be obtained for 220-volt circuits, or the more common 110-volt lamp may be used on such circuits by connecting two of them in series. A 250-volt generator, together with 220-volt motors, are therefore recommended for shop plants.

Alternating-current motors are wound for either 220 or 440, and for similar reasons to the above, the 220-volt system is recommended.

Type and Size of Generator.—As between the direct-connected and belted machines the relative advantages may be thus stated: The direct-connected generator is more compact and more solid in construction, especially in small machines, due to the greater size of its parts. It is therefore more durable and somewhat more efficient on account of elimination of frictional losses in belting.

The belted generator has an advantage of cheapness in first cost, due to its higher speed, which means more output for the same amount of material; and the further fact, often of importance, its ready applicability to existing engine plants.

For generators of 75 h. p. or less, the belted machine answers every practical purpose, but above this size the purchase of direct-connected machine will be found an economy in all new plants.

In planning the installation of a transmission plant with small beginnings of running, say, one electric traveling crane, transfer table, turn-table outfit and a few portable tools, a 75 or 100 h. p. belted generator will be found a convenient unit size. It may be installed cheaply by belting from countershaft at the main shop engine, but it is altogether better to provide a separate engine, for the reasons that the electric drive may be needed twenty-four hours in the day for special work (such as roundhouse turn-table), and it makes a good emergency power plant for portions of the shops working overtime. It may be also used at night to light the roundhouse and other buildings. When the transmission plant outgrows the capacity of this generator, it may still be used as "spare" or for overtime work,

In laying out a complete system of electric transmission to displace engine and shafting transmission, careful attention should, of course, be given to selection of unit sizes. Little advice can be given offhand for such a case, as the determination of average and maximum loads is the basis of all calculations. In large plants, say of 500 h. p. or over, there should be two, and possibly three, units of the direct-connected type and selected so that the engines shall run as far as possible at economical loads, and that one unit may be out of service for repairs.

Calculation of generator capacity required can be made approximately from published data on power required to run machine tools. It is usual to install motors having a considerably larger nominal capacity than figured requirements, so that generator capacity need never be as great as the added capacities of motors attached. In fact, the generator load in an ordinary shop seldom runs above 50 per cent. of that of the combined motor capacity, and in shops having a large motor load the effect on generator of running a traveling crane, a transfer table and turn-table need not be considered, as the momentary overload capacity of the machine will be ample to take care of such requirements.

Rating of Generators.—Generators are sold with a guarantee to deliver their rated capacity, when driven at a certain speed, indefinitely, with a maximum temperature rise, due to electrical losses, of an amount supposed not to be injurious to insulation. This rise should not exceed 40 degrees Centigrade above the temperature of the surrounding air. They are also guaranteed to carry an overload of 25 to 50 per cent. for two hours, and short-period overloads of 100 per cent. without injurious heating. These guarantees have led to the objectionable but common practice of figuring the engine size on the overload capacities; that is, it is quite customary to couple a generator to an engine having its economical rated capacity equal to the 50 per cent. overload capacity of the generator. The consequence is that load is piled on the generator as long as the engine will pull it without seriously dropping off in speed, and an expensive generator is finally ruined for lack of the common-sense precaution which would be furnished by a properly adjusted engine unit.

Motors.—If the direct-current system be adopted, a wide range of selection in motor types is possible.

For line-shafting, motors should be of the shunt type.

For individual tool driving, the shunt motor is also in most common use; but the compound-wound variable speed motor is recommended as a desirable substitute. In fact, it is the belief of your committee that one of the great advantages of electric driving is in the possibility of simple speed regulation for large tools, and the attention of the electrical companies should be called to the importance of filling this requirement in their line of standard motors.

Motors are preferably of "open" construction; that is, with the ends of field frame uncovered. Where exposed to the wet or to mechanical injury from articles falling into it, the closed type of motor may be employed, but this type is not desirable where it can be avoided on account of its lack of ventilation, which means overheating unless the motor is of relatively large size for the work to be done.

For traveling cranes, hoists, transfer tables, locomotive turntables and boiler shop plate rolls, which start under load, run at variable speed, stop and reverse, the series-wound motor is the best, and is preferably of the enclosed style, which allows of more universal connection in any position, by gearing or otherwise, than the open type, and the question of heating is not so serious, on account of intermittent running.

For alternating motors, the same considerations as for the "direct" apply; but, as elsewhere explained, variable speed running in this type for tool-driving motors is not practicable. For crane work, however, the induction motor is successfully applied by attaching speical controlling devices.

In selecting motors, the importance of keeping down the number of sizes should be had in mind. This should be done at the expense of some increase in first cost and in spite of some waste of power due to reduced efficiency of underloaded motors, especially as their reliability is thereby enhanced. Competition among the makers of cheaper grades of motors has resulted in giving ratings dangerously close to the maximum safe working limit, and with all motors a reduction in the working load greatly increases their durability.

In deciding upon the make of motor to be purchased there is the same range for selection as found in other lines of machinery; but as an electric motor is a somewhat delicate machine, it is important to select only those made by reliable manufacturers. Such can be had of several companies, but they are not the lowest in first cost, and, in absence of definite information, it is generally safest to avoid very cheap machines. Even the best manufacturers make motors with different ratings as to speed and heating limits, and the lowest speed and lowest heating limit motors should be selected. This latter should not exceed 40 degrees centigrade rise above external temperature at continuous full load run. The speed should be the so-called "slow-speed" variety. Table No. 2 gives about the proper speed for each of the standard sizes of shunt motors. It also gives the approximate selling prices of the list, based upon the highest grade machines; price includes motor, with pulley, base-frame and belt tightener, and starting box.

A corresponding list of "medium-speed" motors may be obtained, the speed for a given power being about 50 per cent. higher than given in table, the prices being about 20 per cent. less on smaller and 35 per cent. less on larger sizes.

TABLE NO. 2 -SPEED AND PRICES OF SLOW-SPEED DIRECT-CURRENT MULTIPOLAR MOTORS.

| Rated Output, H.-P. | Speed, R. P. M. | Price. | Price per H.-P. |
|---|---|---|---|
| 2 | 1,200 | $135 | $67 |
| 3½ | 1,050 | 190 | 55 |
| 5 | 950 | 240 | 48 |
| 7½ | 850 | 310 | 41 |
| 10 | 750 | 400 | 40 |
| 15 | 650 | 500 | 33 |
| 20 | 600 | 600 | 30 |
| 30 | 575 | 850 | 28 |
| 40 | 550 | 1,050 | 26 |
| 50 | 550 | 1,200 | 24 |

Manner of Tool Driving.—This varies in accordance with the motor arrangement and may be by

(a) The group system.

(b) The individual system.

The selection of one or the other system depends upon the size of the tools and the consideration of intermittent or continuous running. In general, where the tools require less than three-horse-power each, it is best to drive them in groups from short-line shafts, which, as a rule, should not require more than 25 horse-power per shaft group. Where, however, three horse-power or over is required, or where variable speed or intermittent running is desirable, each tool should have its own motor.

In the group system the motor may be either belted to or direct-connected on the end of the line shaft, accordingly as space or plant cost permits.

In individual driving either belted or geared motors are employed. The belted arrangement is somewhat clumsy, but reduces shock and prolongs the life of the motor, and is, in the opinion of your committee, the better arrangement for general use.

Conclusions.

1. In a small shop, consisting of practically one building, having an equipment of small tools for light work only, electric transmission will not be found a paying investment. In such a shop, however, an electric lighting dynamo will be a convenience, and may be utilized to run a few labor-saving electric tools, such as a cylinder-boring outfit, a turn-table motor, etc.

2. In an extensive railway shop plant the installation of a central power station and electric transmission will always be found advisable, as it will not only result in the most economical system in respect to operation, but will make possible far more important shop economies, namely, an increase in quantity and quality of output and a reduction in cost of handling the same.

SUBJECTS FOR 1901.

Committee—R. Quayle, G. W. Rhodes, F. D. Casanave.

FOR COMMITTEE WORK DURING THE COMING YEAR.

1. What is the most economical speed for freight trains?

2. Different types of locomotive fire-boxes now in use, and most promising type for passenger, freight and switch engines?

3. What is the cost of running high-speed passenger trains?

4. The most satisfactory method of handling, cleaning and setting boiler tubes?

5. What is the most promising direction in which to effect a reduction in locomotive coal consumption?

6. What should be the arrangement and accessories of an up-to-date roundhouse.

7. Maximum monthly mileage that is practicable and ad-

visable to make; how best to make it, both in passenger and freight service?

8. What is the most approved method for unloading locomotive coal, prior to being unloaded on the tank?

## WHAT CAN THE MASTER MECHANICS' ASSOCIATION DO TO INCREASE ITS USEFULNESS?

Committee—T. R. Browne, G. M. Basford, L. R. Pomeroy.

This report embodied suggestions for possible improvements in the methods now used by this Association and are summed up in the following:

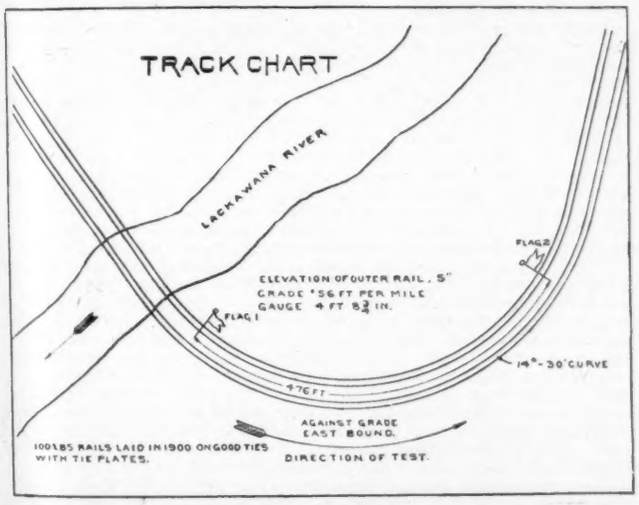
A nomination of officers by a nominating committee; an improved method of admitting associate members; the taking of record votes on questions of practice; more preparations for the introduction of discussions, and more complete plans for their consideration; the abolition of the universal practice of appointing as chairman of a committee the member who suggests the subject for committee investigation to the committee on subjects; recommendations to the president by the committee on subjects of members best qualified to present them; committees of investigation composed of small numbers of individuals; provision for the reception of individual papers; strict adherence to the rule requiring the presentation of long papers by abstract; the co-operation of railway clubs and special organizations in the presentation of opinions on practice, and in the suggestion of subjects for investigation; more explicit instructions to committees as to arrangement, and advancing conclusions in reports; the appointment of several additional standing committees on subjects concerning motive power progress; increased responsibilities of the committee on subjects in the actual work of the convention; provision for a thorough printed index of the proceedings of the Association from the first volume; an effort to make the reports presented to the Association thoroughly reliable; a typographical arrangement of reports which will render the conclusions and decisions more easily found; the establishment of a library similar in plan to that of the Western Railway Club.

## FLANGED TIRES.

Committee—S. Higgins, W. H. Thomas, Wm. Garstang.

"Is it desirable to have flanged tires on all the drivers of mogul, ten-wheel and consolidation engines? If so, with what clearance should they be set?"

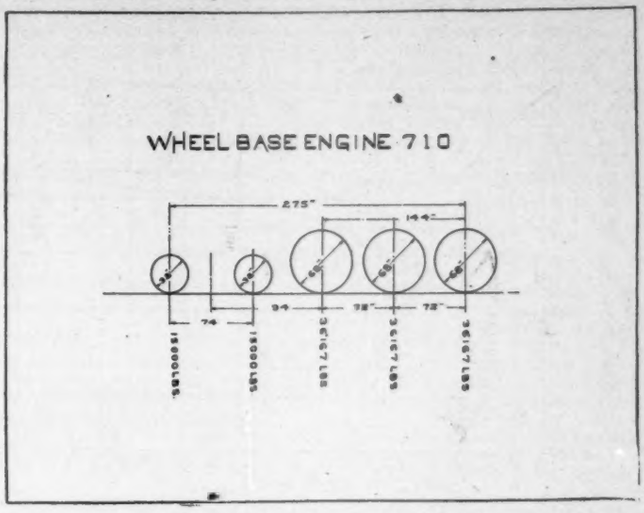
The original report presented one year ago contains the results obtained at that time, which results the committee did not consider to be conclusive on account of the difficulty




experienced in taking the readings of the dynamometer that was placed between the engine being tested and the engine doing the work. The results now presented, in the opinion of the committee, can be taken as conclusive and reliable in every respect, inasmuch as they were obtained with a self-registering dynamometer car of approved construction, the operation of which will be explained further on in the report.

For information concerning present practice as to tire arrangement on mogul, ten-wheel and consolidation engines the members of the Association are referred to the first report.

The committee met in Buffalo, N. Y., last fall, and the meeting was attended not only by the members of the committee, but also by representatives of the Roadway Department. At that meeting it was decided to do the work with a self-registering dynamometer car, the tests to be made on the line of the Lehigh Valley Road at the same place where the tests were made one year ago. The tests to include not only a consolidation engine, but also an engine of the ten-wheeled type. It was furthermore decided that the track on which the tests were to be made should be put in first-class shape with elevation and gauge on curve to represent what is the average practice at the present time. It was decided that a test should be made with ten-wheel type of engine, and with each tire arrangement, on straight track to ascertain the lateral motion of the engine. It was agreed that both engines to be tested should be engines just out of the shop with the




lateral motion between hub of wheel and box 1/16 in. on each side.

The diagram accurately represents the track on which tests were made, the track used being the right-hand or east-bound track, and the flags shown on diagram represent the points between which the readings were taken.

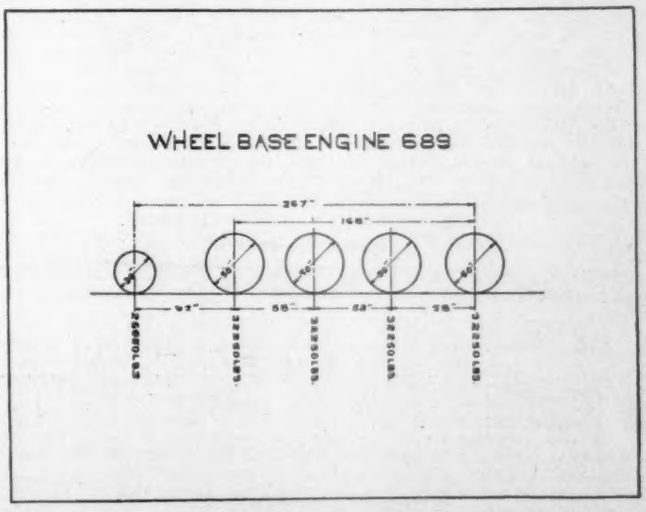
The lateral motion of the ten-wheel engine on straight track with each tire arrangement was determined with an instrument known as a hydrokinetimeter. As before stated, dynamometer tests were made with a consolidation engine, also with an engine of the ten-wheel type.

With both engines main rods and valve rods were disconnected, boiler and tender cisterns were full of water, and there was about two tons of coal on each tender.

The dynamometer tests were made by hauling the engine to be tested through the curve, entering at the lower end so as to have the grade (56 ft. to the mile) to contend with, at speeds approximating ten, twenty and thirty miles per hour for each engine, with each tire arrangement. The start was made at a sufficient distance from the first flag, to enable the engineer to get the test train at the desired speed when passing that flag. The test trains were made up in the following order: First, Engine hauling train; Second, Dynamometer car; Third, Engine being tested. The couplings were blocked with wooden wedges, to take up the slack.

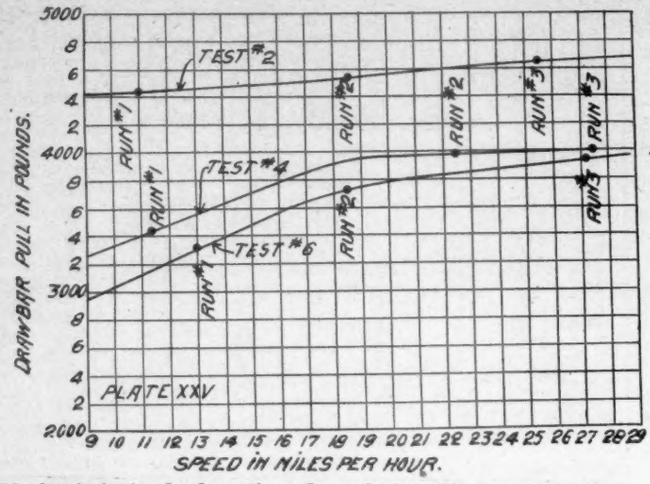
The hydrokinetic tests were made between two semaphores, 2.63 miles apart, on straight and level track. In making the tests the train was started at the first semaphore, and brought to a speed approximating forty miles per hour, which was maintained until the second semaphore was passed, when the train was gradually brought to a stop.

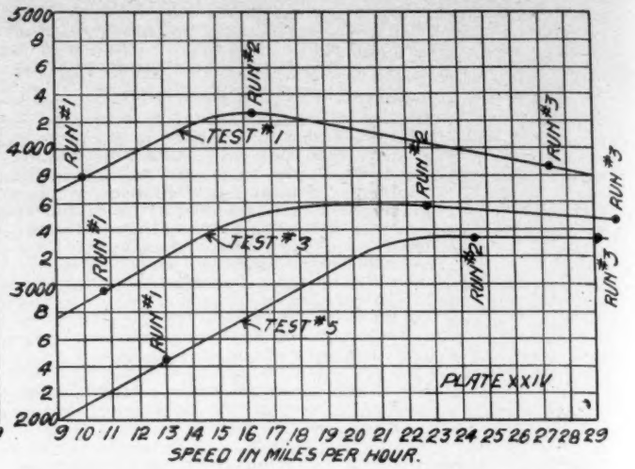
Three series of dynamometer tests were made with each




engine, or six in all. The first test was made on the morning of April 10, and the tests were finished on April 12. The distance between backs of flanges on engine truck wheels in all tests was 53¼ in. The distance between backs of flanges on driving wheels, in all tests except No. 6, was 53¼ ins. In test No. 6 the distance between backs of flanges on front and back pair of drivers was 53⅛ in., while this distance for the middle drivers was 53¼ in.

The plain tires were located on driving-wheel centers so that the center of the tread of tire coincided with the center of the rail head on straight track. Tires used were Master




Mechanics' standard section, flanged tires 5¾ in. wide, plain tires 6½ in. wide.

The records obtained in the dynamometer test are shown in the table at the end of this report. A comparison of results of the tests on engine No. 710 is shown on Plate 24, and on engine No. 689 on Plate 25 (reproduced here). The results obtained from engine No. 710 by the hydrokinetic tests are shown on Plate 26, reproduced as follows:

HYDROKINETIMETER TESTS, ENGINE 710.

| Test Number. | 1 | 3 | 5 |
|---|---|---|---|
| Average speed, miles per hour | 39.86 | 34.15 | 33.4 |
| Maximum speed, miles per hour | 40.00 | 40.60 | 38.90 |
| Height of float at start, inches | 12 | 12 | 12 |
| Volume of water at start, cu. in | 3096 | 3096 | 3096 |
| Height of float at finish, inches | 6 7/16 | 6 1/16 | 6 3/16 |
| Volume of water at finish, cu. in | 1693.13 | 1580.25 | 1596.27 |
| Volume of water displaced, cu. ins | 1402.87 | 1515.75 | 1499.63 |
| Per cent. of water displaced | 45.32 | 48.96 | 48.44 |

Test No. 1 was made on the 10-wheel engine with rigid truck and forward drivers plain. In all the other tests swing motion trucks were used. Test No. 2, consolidation, had second and third pairs of tires plain. Test No. 3, 10-wheel engine, had plain tires on the middle drivers. Test No. 4, consolidation engine, had plain tires on the second pair of drivers. Tests 5 and 6, 10-wheel and consolidation respectively, had flanged tires on all wheels.

The hydrokinetimeter consists of a reservoir 18½ in. in diameter, 12 in. deep, with a copper float in the center to permit of accurate measurement of the volume of water displaced; the different volumes of water displaced indicating the lateral motion of the engine as affected by the different tire arrangements, and before starting it was filled with water. At the end of the run the water remaining in the instrument was measured and the difference represented the volume of water displaced. The instrument was bolted on top of the fireman's shield, which is fastened to the top of the back boiler head.

The results obtained justify the members of the committee in concluding that it is desirable to have flange tires on all the drivers of mogul, ten-wheel and consolidation engines. With mogul and ten-wheel engines the tires should be set so that the distance between the backs of flanges will be 53¼ in. With consolidation engines the tires on front and back pairs of wheels should be set so that the distance between backs of flanges will be 53⅛ in.; with the other two pair of drivers the tires should be set so that the distance between backs of flanges will be 53¼ in.

It should be understood that the committee assumes that the engines will have swinging trucks.

SUMMARY OF DYNAMOMETER TESTS.

ENGINE 710 (10-WHEEL).

| Test No. 1. | | | Test No. 3. | | | Test No. 5. | | |
|---|---|---|---|---|---|---|---|---|
| Run. | Speed, m. p. h. | Load, lbs. | Run. | Speed, m. p. h. | Load, lbs. | Run | Speed, m. p. h. | Load, lbs. |
| 1 | 9.967 | 3,780 | 1 | 10.90 | 2,970 | 1 | 12.975 | 2,450 |
| 2 | 16.200 | 4,260 | 2. | 22.95 | 3,560 | 2 | 24.500 | 3,350 |
| 3 | 27.375 | 3,860 | 3 | 29.70 | 3,470 | 3 | 29.150 | 3,327 |
| Ave'ge | 17.814 | 3,967 | Ave'ge | 21.183 | 3 333 | Ave'ge | 22.208 | 3,042 |

ENGINE 689 (CONSOLIDATION).

| Test No. 2. | | | Test No. 4. | | | Test No. 6. | | |
|---|---|---|---|---|---|---|---|---|
| Run | Speed, m. p. h | Load, lbs. | Run. | Speed, m. p. h. | Load, lbs. | Run. | Speed, m. p. h. | Load, lbs. |
| 1 | 11.030 | 4,440 | 1 | 11 930 | 3,440 | 1 | 13.083 | 3,306 |
| 2 | 18.640 | 4,540 | 2 | 22 675 | 3,990 | 2 | 18.600 | 3,730 |
| 3 | 25.700 | 4,640 | 3 | 27.550 | 4,060 | 3 | 27.325 | 3,940 |
| Ave'ge | 18.790 | 4,540 | Ave'ge | 20.518 | 3,830 | Ave'ge | 19.669 | 3,657 |

## BEST TYPE OF STATIONARY BOILERS FOR SHOP PURPOSES.

Committee—J. F. Dunn, J. J. Ryan, John Hickey.

For a medium-sized steam plant, such as is ordinarily required for a railroad repair shop, a well-constructed and properly set horizontal tubular boiler with fire-brick lining gives very good and economical results under varying conditions of water, fuel and the average fireman, where the steam pressure to be carried does not exceed 125 lbs. per square inch and simple non-condensing engines are to be used; as in a properly constructed return tubular boiler, the radial surface of the shell exposed to the action of the fire is accessible, and the interior can easily be kept clean, and the heating surface of the shell exposed to the fire does nearly 50 per cent. of the total work of the boiler.

With water-tube boilers, the heating surface being almost entirely confined to the tubes, the insoluble salts are deposited and adhere to the interior surface of the tubes in spite of the vigorous circulation claimed for this type of boiler, but the introduction of soda ash and lime into the feed-water will, of course, act equally as favorable in this type of boiler as in the others in the prevention of scale forming, and while ordinarily it might be considered a difficult matter to keep such tubes clean, and that the cost of maintenance might be greater owing to the liability of the tubes leaking where set in the headers and uptakes, yet all reports received by your committee indicate the contrary when fairly good feed-water is used, and invariably those who have used this type of boiler mention it very favorably, especially the type having straight tubes (without bends) that are easily accessible at both ends. It is doubtful, however, whether the water-tube boiler can show much better efficiency than a properly designed and properly set return tubular boiler under all conditions. If, however, the magnitude of the steam plant is designed for compound condensing engines a properly constructed, first-class water tube boiler may be preferable to the return tubular for the reason that it is economical to carry steam at a higher pressure on compound engines than has heretofore been the practice with the return tubular boiler. It appears to be the prevailing practice at the present time, especially so in large steam plants, to use water-tube boilers capable of carrying a working pressure of 180 to 200 lbs. per square inch in connection with compound condensing engines, as, with the water-tube type of boiler, its heating surface is considered more effective because of having the heating surface made of very much thinner material than is possible with the return tubular boiler designed to carry such a high pressure.

Another important point claimed for the water-tube boiler is its comparative freedom from disastrous explosions in comparison with the various other types owing to the subdivision of the water spaces into smaller volumes, or areas, and that repairs can be made much quicker on account of not having to wait so long for boilers to cool down as with the return tubular type, owing to the heat contained in the shell and brick settings of the latter; and the ordinary repairs in the former generally consisting in the renewal of a tube, header or uptake, which can be replaced in much shorter time than patching the shell of return tubular boilers, which quite often necessitates removing a portion of the brick settings. It seems to be generally conceded, however, that the return tubular type furnishes the drier steam.

The locomotive type of boilers with internal firebox deserves some mention on the following point of merit, namely, they are portable, which permits of their being easily removed from one point to another, and are a type with which the average shopmen are familiar and can readily make repairs, and it requires no expensive brick settings, taking up less room than either the return tubular or water-tube type, and the heat from the fuel is absorbed entirely by the heating surfaces of

the boiler; whereas with the return tubular and water-tube type, the brick walls enclosing the boilers absorb and radiate considerable of the heat. However, your committee does not consider them as economical on fuel as the other types mentioned, for the reason that as a rule quite a portion of their heat-radiating surfaces are exposed to the varying conditions and changes of atmosphere, thereby causing loss of heat by radiation. They also require more attention in firing, owing to the limited grate area, and as a whole the locomotive type of boiler is much more expensive in construction in maintenance than the return tubular type and can only be recommended to be used as is the generally prevailing custom, namely, utilizing such boilers as a temporary expedient as are discarded from locomotives.

It appears that the general practice is to use tubes 3 in. in diameter for hard or anthracite coal; 3½-in. tubes for first quality bituminous or high-grade soft coal, and 4-in. tubes for low-grade bituminous coal; the tubes being not less than 12 nor more than 18 ft. in length. The ratio of grate area to heating surface for return tubular boilers with a natural draught, using ordinarily good bituminous coal as fuel, is about 1 sq. ft. of grate area to 35 sq. ft. of heating surface, and for water-tube boilers, with like conditions, the mean average ratio is practically 1 sq. ft. of grate area to 45 sq. ft. of heating surface; but with anthracite coal the ratio is somewhat less, and the mean average ratio of heating surface per horse-power averages 12½ sq. ft. for return tubular boilers and 10 sq. ft. for water-tube boilers.

Your committee regrets that it is not prepared to make any recommendations as to preference between the return tubular or water-tube type of boilers, and simply mention that either type is both efficient and economical under the conditions as mentioned in the foregoing report. The important factor governing either type is to have it of adequate capacity to meet the varying demands of the load without having to be forced to its maximum capacity, at which point any type of boiler ceases to be economical. It is also desirable to have as large a grate area as practicable within reasonable limits, to permit of burning slack or refuse coal, and the smokestack should be of ample area in both diameter and height, as a good draught and consequent greater heat tends to more perfect combustion, especially of the volatile part of the fuel, of which almost all American bituminous coals contain a large amount.

Another very important factor of which the members of this Association are cognizant, but which quite often is not given the attention its importance deserves, is the matter of keeping boilers, including the brick walls (of the settings), tight and free from leaks and the interior of the boiler as clean as possible under existing conditions, as a very small leak in the boiler will very often materially affect the evaporative efficiency, and the leak, if only a simmer, if allowed to continue, forms corrosion which eats the plates away and eventually necessitates the application of a patch, which could be prevented by a few minutes' caulking at the start.

(To Be Continued.)

## INCREASE IN THE USE OF THE PINTSCH LIGHTING SYSTEM.

At the close of each year it is the custom of the Julius Pintsch Company of Berlin, Germany, to make a report showing the number of cars that have been equipped in the various countries with the Pintsch system of gas lighting; also the new buoys supplied for harbor and channel lighting, and the number of gas works that were erected during the past twelve months.

The report for the year closing December 31, 1899, showing the progress made with the Pintsch system, which is now in use in twenty-one countries for lighting cars and buoys, has just been received and is printed below. It is evident from the large number of cars equipped in the year 1899, which are 7,292, that there is a constant extension of this system of car lighting by roads that some years ago adopted it, and also a rapid adoption of the system by smaller roads, which have postponed making a change from oil to gas.

Statement for 1899.

| | Cars. | Locomotives. | Gas Works. | Buoys and Beacons. |
|---|---|---|---|---|
| Germany | 36,305 | 3,784 | 71 | 98 |
| Denmark | 45 | .... | 3 | 21 |
| England | 18,290 | 18 | 87 | 236 |
| France | 5,425 | .... | 22 | 238 |
| Holland | 3,166 | 114 | 9 | 60 |
| Italy | 1,528 | .... | 4 | 15 |
| Switzerland | 380 | 9 | 1 | .... |
| Austria | 3,211 | .... | 10 | 1 |
| Russia | 2,275 | 57 | 13 | 13 |
| Sweden | 475 | 8 | 4 | 2 |
| Servia | 154 | .... | .. | .... |
| Bulgaria | 33 | .... | 1 | .... |
| Turkey | 103 | .... | .. | .... |
| Egypt | 2 | .... | 3 | 112 |
| Canada | 49 | .... | 2 | 46 |
| Brazil | 974 | 31 | 1 | 31 |
| Argentine | 1,041 | .... | 10 | 2 |
| Chili | 46 | .... | 1 | .... |
| India | 7,744 | .... | 10 | .... |
| Australia | 2,053 | .... | 3 | 29 |
| United States | 14,883 | .... | 51 | 134 |
| Total | 98,182 | 4,021 | 306 | 1,038 |
| Increase for the year | 7,292 | 367 | 3 | 146 |

The new locomotive equipments furnished in the various countries in 1899 were 367. These are used almost exclusively in Europe, and, in fact, all but 31 were for European roads, the 31 being supplied to railroads in Brazil. There were three new Pintsch gas works erected in 1899, and 146 new buoys and beacons supplied to the various governments. The total number of cars now equipped with Pintsch gas throughout the world foot up to 98,182. These figures, as before stated, were up to December 31, 1899, and it is safe to say that there are now throughout these 21 countries over 100,000 cars so equipped. The total number of locomotives now figure up to 4,021; gas works, 306; and buoys and beacons 1,038. These figures are interesting and speak well of the satisfaction that results from the use of the Pintsch system.

## EXHIBITS AT THE CONVENTION.

The following is a list of the exhibits at the Mechanical Conventions at Saratoga, N. Y.:

Adams & Westlake Company, Chicago, Ill.—Exhibited Adlake acetylene gas car lighting system.

American Balance Slide Valve Company, Jersey Shore, Pa., and San Francisco, Cal—Exhibiting American balance slide valves for locomotives, marine and air engines and American balanced piston valves.

American Brake Company, St. Louis, Mo.—Locomotive brakes and engine truck brakes, automatic slack adjuster.

American Brake Shoe Company, Chicago.—Exhibiting brake-shoes.

American Car & Foundry Company, St. Louis.—Canda box car, designed for 100,000 pounds' capacity; Canda self-clearing wooden gondola car, designed for 100,000 pounds capacity; D. L. & W. structural steel hopper car, class S. H. 50, for coal and ore, designed for 110,000 pounds' capacity.

American Carbide Lamp Company, Philadelphia.—Exhibit of lighting device in Boston & Albany car No. 84 at foot of Washington street.

American Locomotive Sander Company, Philadelphia, Pa.—Pneumatic track sanders—Leach, Houston, She, Curtis and Dean.

American Steam Gauge Company, Boston, Mass.—Standard locomotive gauges with rigid or hanging non-corrosive movements, Duplex air brake gauges, pop safety valves, original Thompson improved indicators.

American Steel Foundry Company, St. Louis, Mo.—Exhibiting models of steel trucks and body bolsters.

Armstrong Bros. Tool Company, Chicago, Ill.—Complete line of planer and machine shop tools.

Atlantic Brass Company, New York, N. Y.—A. B. C. journal bearing.

Atlas Railway Supply Company, Chicago, Ill.—Samples of Atlas primer and Atlas surfacer, made under the Thomas S. Vaughn formula for passenger cars and locomotives; also their I. X. L. composition forall kinds of wood and ironwork.

Automatic Air & Steam Coupler Company, St. Louis, Mo.—Model of the device.

Automatic Track Sanding Company.—Manufacturers pneumatic track sanders, both hand and pneumatic, for all classes of locomotives, Boston, Mass.

Ball Bearing Company, Boston, Mass.—Ball bearings.

Baltimore Ball Bearing Company, Baltimore, Md.—Ball side bearings.

F. W. Bird & Son, East Walpole, Mass.—Torsion proof car roof.

Bierbaum & Merrick Metal Company, Buffalo, N. Y.—Lumen bronze, car bearings, side rod brasses, etc.

R. Bliss Manufacturing Company, Pawtucket, R. I.—Wood's platform gate for steam, elevated and street cars; Crone's patent air gate for steam and elevated railways.

Boston Artificial Leather Company, 12 East Eighteenth street, New York.—Car seats covered with moroccoline, strips of moroccoline in different colors and grains.

Boston Belting Company, Boston.—Samples of air brake, steam and car heating hose, mats, matting.

Bradley Company, Syracuse, N. Y.—Bradley hammers and forges.

Butler Drawbar Attachment Company, Cleveland, O.—Tandem attachments.

Carborundum Company, Niagara Falls, N. Y.—Carborundum wheels; also Yankee drill grinders and specialties, cloth and paper.

L. C. Chase & Co., Boston, Mass.—Exhibiting complete line of Chase plushes, made at the Sanford mills, consisting of plain and frieze goods; also a new line of artificial leathers.

Chicago Pneumatic Tool Company, Chicago, Ill.—Exhibiting Chicago reversible drills in five different sizes; Boyer drill, two sizes; Chicago rotary drill, four sizes; flue cutters, flue welders, Chicago piston breast drills, Chicago rotary breast drills, 10-horse-power motor, Boyer long stroke riveting hammer, Boyer clipping and calking hammer, shell riveters, Boyer speed recorder, Chicago sand rammers, Chicago painting machine, Chicago oil rivet forges, Boyer yoke riveters, Chicago staybolt biter, Chicago staybolt chuck, Ford dolly bars, pneumatic holder-on.

Chicago Grain Door Company, Chicago, Ill.—Grain door, security and lock brackets.

Chicago Railway Equipment Company, Chicago, Ill.—National hollow, Kewanee, Diamond and Central brakebeams, automatic frictionless side bearings, and have a specially adapted brakebeam for high-speed brake service.

Cleveland City Forge Works, Cleveland, O.—Turnbuckles and drawbar pockets.

Cloud Steel Truck Company, Chicago, Ill.—Cloud pedestal truck, Cloud pressed steel archbar truck, Bettendorf I-beam body and truck bolster.

Consolidated Car Heating Company, Albany, N. Y.—Exhibiting steam, hot water and electrical car heaters.

Consolidated Railway Electric Lighting & Equipment Company, New York, N. Y.—Model of the system of lighting cars by electricity generated from the axle; also a private car equipped with this system of electric lights and fans in operation.

Crosby Steam Gauge & Valve Company, Boston, Mass.—Waterback locomotive gauges, muffler and plain pop valves, chime whistles, spring seat globe and axle valves, Johnstone blow-off valve.

Curran & Burton, 70 Kilby street, Boston, Mass.—Exhibiting the Huff track sanding device, Huff automatic steam blower, Huff auxiliary variable exhaust.

Curtain Supply Company, The, Chicago, Ill.—Exhibiting Burrowes and Forsyth "roller tip" and Acme and Climax "cable" car curtains and fixtures.

Dayton Malleable Iron Company, Dayton, O.—Five draft riggings, complete, of four different types, single and double spring with malleable iron and wooden draft sills.

Frank S. De Ronde Company, New York and Philadelphia.—Lythite paint and painting machinery.

Detroit Lubricator Company, Detroit, Mich.—Detroit lubricators with the Tippett attachment, back pressure values for steam chests.

Drexel Railway Supply Company, Chicago.—The Schroeder grain door and Cardwell brakeshoe.

Dunlap & Plum, Columbus, O.—The U. & W. piston air drill.

O. M. Edwards, Syracuse, N. Y.—Window fixtures.

Fairbanks Company, New York, N. Y.—Exhibiting Fairbanks valves, Merrell pipe machines, Oster stocks and dies, Nicholson compression coupling, Nicholson adjustable mandrel, Dart couplings and flanges, Durable wire rope, Walker magnetic chuck, vulcabeston packing, pneumatic drills.

Garry Iron & Steel Roofing Company, Cleveland, O.—Exhibiting revolving pneumatic crane and a pneumatic car jack.

Gem Manufacturing Company, Pittsburg, Pa.—Gem oiler.

Gold Car Heating Company, New York and Chicago.—Car heating apparatus, duplex coil system and straight stem operated under steam; also various parts of apparatus shown separately.

Goodwin Car Company, New York, N. Y.—Steel model of car, full size section drawings and photographs.

Gould Car Coupler Company, 25 West Thirty-third street, New York, N. Y.—Showing passenger and freight slack adjusters, improved M. C. B. Journal box, model of the improved malleable draft rigging for freight equipment with spring buffer blocks; a quarter size model of the Gould vestibule continuous buffer, M. C. B. passenger coupler and improved steel passenger platform.

M. C. Hammet, Troy, N. Y.—Richardson balanced valves, link grinders and Sansom bell ringer.

Harrison Dust Guard Company, Toledo, O.—Exhibiting the Harrison dust guard in the four following sizes: 40,000, 60,000, 80,000, 100,000 pounds' capacity.

Hale & Kilburn, Philadelphia, Pa.—Pressed steel car seats.

Heywood Bros. & Wakefield, Boston and New York.—Exhibiting car seats, showing Wheeler, Henry and Bushnell makes, rattan parlor car chairs.

Illinois Malleable Iron Company, Chicago.—The Bruyn auto swinging smoke jack.

International Correspondence Schools of Scranton, Pa.—Demonstrating car in charge of W. N. Mitchell. Located on D. & H. track.

H. W. Johns Manufacturing Company, New York.—Full assortment of asbestos goods. Specialties in fire felt, locomotive lagging, Kearsarge gaskets and vulcabeston for piston rods; packing valves; stems and air brake packing rings.

Joyce, Cridland Company, Dayton, O.—Hydraulic jacks, geared lever jacks, screwjacks and single lever jacks.

Philip S. Justice & Co., Philadelphia, Pa.—Reliance hydraulic jacks.

Keasbey & Mattison Company, Ambler, Pa.—Magnesia locomotive lagging and train pipe covering.

Keystone Drop Forge Works, Philadelphia, Pa.—The Keystone connecting link. To take the place of a weld for connecting brake, guard or wrecking chains.

Koko Cream Company, New York.—Preparation for cleaning varnished surfaces and interior of cars.

Lappin Brake Shoe Company, New York.—Car and locomotive brakeshoes.

Leach & Simpson, Chicago, Ill.—The Ferguson locomotive fire kindler.

Locomotive Appliance Company, Kansas City.—Exhibiting model of Economic valve.

Lunkenheimer Company, Cincinnati, O.—Injectors, globe valves and swing check valves.

Manhattan Rubber Manufacturing Company, New York.—Air brake hose, rubber packing, Victor driving brake packing, hard rubber valves, gaskets, zigzag stitched belt.

Manning, Maxwell & Moore, New York City.—Metropolitan injector, Hancock single and double inspirators, boiler checks and main steam valves, intermediate swing checks for delivery pipes, duplex boiler check with inside stop valve, Ashcroft steam gauges and Consolidated safety valve.

McCord & Co., Chicago and New York.—McCord journal box, McCord coil spring damper, Johnson hopper door.

Michigan Lubricator Company, Detroit, Mich.—Michigan improved triple lubricator No. 3, and automatic steam chest plugs, also air brake cups.

Monarch Brake Beam Company, Detroit.—Monarch and solid brakebeams.

Moran Flexible Steam Joint Company, Louisville, Ky.—Large joints and all-metal steam-heat couplings.

National Car Coupler Company, Chicago.—Automatic car coupler.

National Elastic Nut Company, Milwaukee, Wis.—Exhibiting self-locking steel nuts.

National Railway Specialty Company, Chicago, Ill.—N. R. S. journal bearing key, Royal dustguard.

National Malleable Castings Company, Cleveland, O.—Tower couplers, Stevenson dustproof oil box and lid.

National Lock Washer Company, Newark, N. J.—Exhibiting the National sash lock.

New York Compressor Company, New York, N. Y.—One straight line and one duplex compressor.

A. O. Norton, Boston, Mass.—The Norton patent ball-bearing jacks and "sure drop" track jacks; also a full line of other jacks for all kinds of service.

The Pantasote Leather Company, New York.—Exhibit showing section of palace car fitted with pantasote curtains, head linings and upholstery.

Peerless Rubber Manufacturing Company, New York.—Air brake hose, steam hose, engine and tender hose, gas hose, packings, rubber matting, hose for pneumatic tools, etc.

Pearson Jack Company, Boston, Mass.—Pearson jacks, Pearson kingbolt clamp, Goodwin brakebeam clamp.

Penberthy Injector Company, Detroit, Mich.—Erwin steam ram.

Pneumatic Crane Company, Pittsburg, Pa.—Exhibiting self-propelling hoist and trolley, with unlimited travel and reversing air motor.

Powers Regulator Company, Chicago, Ill.—Temperature controlling apparatus.

Pressed Steel Car Company, Pittsburg, Pa.—Exhibiting N. Y. C. flat car; C. & A. flat-bottomed gondola, capacity 100,000 pounds; Great Northern hopper gondola ore car, designed to carry 110,000 pounds of ore; Erie hopper gondola coal car, designed to carry 110,000 pounds of coal, new type, having no side sills; P. R. R. hopper gondola coal car, with side sills, designed to carry 119,870 pounds of coal; also Buckeye truck frame.

Railway Appliance Company, Chicago.—Gilman-Brown emergency knuckle.

Rand Drill Company, New York, N. Y.—Rand compressor.

Roberts Car & Wheel Company, Three Rivers, Mich.—Pressed steel wheel, also an emergency air brake hose clamp.

Safety Car Heating & Lighting Company, New York, N. Y.—Exhibiting car lighting and heating apparatus. The new features are fancy deck lamps, bracket lamps, gas ranges for private cars and buoy lantern.

Schenectady Locomotive Works, Schenectady, N. Y.—One New York Central mogul, one Northern Pacific 10-wheel compound and one Northwestern fast express engine.

Simplex Railway Appliance Company, Chicago, Ill.—Simplex bolsters for 80,000-pound capacity cars, also same for 60,000-pound. Susemihl frictionless roller side bearing.

Smillie Coupler & Manufacturing Company, Newark, N. J.—Smillie improved coupler.

Standard Coupler Company, New York.—Standard steel platform and improved standard pressure coupler.

Standard Pneumatic Tool Company, Chicago, Ill.—Pneumatic drills, boring machines, pneumatic hammers, reversible boring machines, reversible flue rolling machines, chain hoists, reversible staybolt, reaming-tapping machines, long stroke riveters and yoke riveters.

Sterlingworth Railway Supply Company, Easton, Pa.—Exhibiting rolled steel car, Sterlingworth rolled steel truck, Sterlingworth rolled steel body and truck bolster and Sterlingworth rolled steel brakebeam.

Standard Paint Company, New York.—"Ruberoid" locomotive cab roofing, paints for iron or wood exposed to dampness or the action of acids or alkalies, preservative paints.

Standard Railway Equipment Company, St. Louis, Mo.—Pneumatic tools.

Star Brass Manufacturing Company, Boston, Mass.—Air and steam gauges, chime whistles, pop valves.

Thornburgh Coupler Attachment Company, Detroit, Mich.—Coupler attachments for all classes of equipment, either with single, double or triple springs, with or without metal draft arms.

United & Globe Rubber Manufacturing Companies, Trenton, N. J.—Exhibiting a full line of rubber supplies for railroad use.

Universal Car Bearing Company, Chicago.—Car bearings.

Universal Railway Supply Company, Chicago.—Car doors.

Walworth Manufacturing Company, Boston, Mass.—Ratchets, Stilson wrenches, stocks and dies; pipe taps, pipe vises, pipe cutters, nipple holders, Smith's railway track ratchet, steam whistles.

West Disinfecting Company, New York.—Disinfecting appliances.

Western Railway Equipment Company, St. Louis.—Combination lug and follower casting, Economy slack adjuster, tandem combination lug and follower, sill and carline pocket, bell ringer, Western flush door, interchangeable door, safety and security truck and casting, the Mudd sander, the Lindstrom non-freezing suction pipe, St. Louis flush door, Acme pipe clamps, Downing card holder, Acme tender pocket, lugless draft beam, side bearings.

J. H. Williams & Co., Brooklyn, N. Y.—Exhibiting car wrenches, track wrenches, hoist hooks, eyebolts, pipe wrenches and special forgings.

Woven Steel Hose & Cable Company, Trenton, N. J.—Exhibiting woven steel hose.